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ON THE DETERMINATION OF THE COEFFICIENTS OF THE GAUSSIAN GENERAL THEORY OF THE EARTH'S MAGNETISM FOR THE YEAR 1885 AND ABOUT THE RELATIONSHIP OF THE THREE EARTH-MAGNETIC ELEMENTS

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Translation of: "Ueber die Bestimmung der Coefficienten der Gaussischen Allgemeinen Theorie des Erdmagnetismus fur das Jahr 1885 und Ueber den Zusammenhang der drei erdmagnetischen Elemente", St. Petersburg, A. Yakobson Printer, May 1897, pp 1-85

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16. Abstract

An attempt is made to judge the value of the Gaussian series for the Earth's magnetism. The computation employed to do chis uses the method of the least and greatest coefficients. The number of unknowns which had to be calculated from the individual groups was at most only four. All symbols of Gauss have been retained.

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I. ON THE DETERMINATION OF THE COEFFICIENTS OF THE GAUSSIAN GENERAL THEORY OF THE EARTH'S MAGNETISM FOR THE YEAR 1885 AND ABOUT THE RELATIONSHIP OF THE THREE EARTH-MAGNETIC ELEMENTS. */1

Almost six decades have now passed since Gauss published his treatise "The General Theory of the Earth's Magnetism" in 1833 in "The Results from the Observations of the Magnetic Society"[1]. Soon thereafter, in 1840, the well known "Atlas of the Earth's Magnetism" by Gauss and Weber appeared which was calculated on the basis of the theory. From the then available observations, Gauss had calculated only the first 24 coefficients which are contained in P', P", P''' and P^{iv}. Moreover, this seems justified if we consider the deficiency of the magnetic measurements of the Earth available to him. Unfortunately, later calculators of the Gaussian formulas--Erman and Petersen[2], Petersen and Neumayer[3] and Quintus Teilius--have remained with this limited number of coefficients, 24, although they represent the observations only very roughly. The causes of these mistakes are certainly the following. In the first place, Gauss himself (GWV, pp. 146-148) overemphasized the difficulty of calculating the coefficients g, h of his theory from the observations; then he only hinted at the only useful, practical method (loc. sit.) which he recommended, but did not put it in a form suitable for calculation. This method was carried out to a limited extent by Erman and Petersen and apparently by the other scholars named, but not very successfully. Finally,

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1) Reprinted again in 1867 in the fifth volume of Gauss's works, pp 121-193. In the sequel, I shall designate this work by GWV".

2) "The Foundations of the Gaussian Theory and the Phenomena of the Earth's Magnetism in 1820", by A. Erman and H. Petersen, published by the Imperial Admiralty, Berlin, 1874.

3) "Atlas of the Earth's Magnetism", by Dr. George Neumayer. Introduction pp 18-20, in "Berghaus Physical Atlas IV", Gotha, Justus Perthes, 1891.

*Numbers in margin indicate pagination of foreign text.

Gauss and Weber have misled the later calculators of the theory through a remark which is on page 32 of their Atlas of the Earth's Magnetism. This remark reads: "As regards the comparison of the theory and experience through the entry of individual observations in our charts and graphic representation of the differences, these /2 would of course not be without interest, but would be useful only if the observations were numerous enough, reliable and nearly simultaneous so that this comparison could be the basis of a corrective calculation. For this purpose, it is not necessary that these observations originate in the year 1830, for which the magnetic state of the Earth is determined in the present charts. No such observations exist from this time. But certain observations can only be made in the future. Nevertheless, their comparison with the theory through entry into our charts and graphical representations of the differences can serve as the basis for a corrective calculation. To be sure, this will not determine better the magnetic state of the Earth for the past epoch, but it will determine the state for the new epoch with an exactitude which far surpasses the present precision. Thus, it is hoped that such a more complete and more reliable system of simultaneous observations will soon be carried out and that the here indicated use will soon be made of it".

Dr. Neumayer quotes the above words of Gauss and Weber on page 9 of his Atlas[4)] and he believes he attains his goal, i.e., greater agreement between theory and observations by means of an extension of the theory developed by Gauss, and entry of the differences between the incompletely calculated Gaussian series (only 24 coefficients) and observation. (e.g., Neumayer's Atlas, text page 20).

However, it is clear that if only 24 coefficients g, h of the Gaussian series are calculated, we cannot obtain for them very correct

4) The theoretical works of Dr. A. Schmidt (Gotha) which are mentioned by Dr. Neumayer on page 20 are unfortunately not available to me: I have only read some hints concerning them. His calculations seem not to have extended beyond $_{P}V$ whereas $_{P}VI$ is still perceptible.

values, since in these calculations, the g and h values are not independent of each other due to the fact that somewhat different values must come out for the first 24 g, h, when we raise the number of unknowns from 24 to 35 or 43 or 63. Of course, the influence of the later g, h on those preceding becomes less, the more coefficients are calculated.

Now since it has been established that the magnetic elements observed on the surface of the Earth consist essentially of two parts, one which progresses regularly and an anomalous part, which has in part the character of a chance phenomenon and in part the character of a systematic phenomenon, therefore, in order to pass a definitive judgment on the value of the Gaussian series, the series must be developed far enough and so many of the coefficients g, h must be obtained that inclusion of new coefficients no longer diminishes the difference between computation and observation and the remainders display as much of a random character as possible. This holds for my calculations below which are based on the excellent charts of Director G. Neumayer (Hamburg) in connection with the transition from P^{V} to P^{VI} so that the number of required g, h does not exceed 48. All told, I have computed 63 coefficients and have found that the /3 work is by no means very great, provided that one goes about it correctly. In this connection, I did not use the method of least squares, but the method of the least and greatest coefficients whereby the computation was considerably facilitated. The number of unknowns which had to be calculated from the individual groups amounted at most to only four.

I have retained almost all of the symbols which Gauss used. However, I have renamed the superscripts of P more briefly with Roman numerals and I have designated the indices of k, l, m, K, L, M, of $\cos n\lambda$ and $\sin n\lambda$ in the formulas for X, Y, Z by 0, 1, 2, 3, 4, 5, 6, 7, while Gauss uses dashes; finally, I have called the horizontal intensity τ, while Gauss uses ω. I now pass on to the exposition of the course of my computations. First of all, I borrowed the

following declinations δ of Table (1), the inclinations i of Table (2) and the horizontal intensity τ of Table (3) which are based on observations for the year 1885, from the charts of Dr. Neumayer.

λ is the longitude east of Greenwich, φ is the latitude and u is the angular distance from the North Pole so that $\varphi + u = 90°$.

Declinations δ for 1885 according to the chart

TABLE (1)

λ =		0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°
u	φ												
10°	+80°	+24,9	+12,2	-0,8	-11,3	-19,7	-22,4	-35,0	-35,2	-31,8	-30,2	-34,0	-35,0
20	+70	+22,4	+10,5	-0,5	-10,8	-17,7	-21,3	-20,5	-13,1	-2,3	-4,5	-5,6	-14,0
30	+60	+20,0	+10,4	+0,8	-7,1	-13,0	-15,0	-11,3	-3,9	+2,5	+6,0	+3,6	-4,0
40	+50	+17,4	+10,3	+2,9	-3,7	-8,2	-10,2	-7,8	-1,6	+4,0	+7,5	+3,9	-3,2
50	+40	+15,6	+10,1	+4,4	-0,7	-4,6	-6,4	-5,3	-1,4	+3,6	+5,9	+1,9	-4,8
60	+30	+14,4	+10,0	+3,6	+1,4	-1,1	-3,3	-4,3	-1,9	+1,9	+3,2	-0,5	-6,0
70	+20	+15,0	+10,9	+4,7	+3,0	+0,3	-1,6	-2,9	-2,7	-0,1	+0,6	-2,4	-7,0
80	+10	+16,7	+12,5	+6,1	+4,5	+1,7	-0,5	-2,3	-3,1	-1,5	-1,1	-4,0	-7,6
90	0	+19,1	+15,0	+10,3	+6,5	+3,1	+0,1	-1,4	-2,4	-2,3	-2,4	-5,2	-8,1
100	-10	+22,7	+19,0	+14,1	+9,3	+5,9	+3,0	+0,8	-1,1	-1,8	-3,2	-6,2	-8,7
110	-20	+26,0	+23,8	+19,7	+13,0	+9,5	+7,0	+4,5	+2,0	-0,8	-3,7	-7,3	-9,6
120	-30	+28,1	+29,0	+26,6	+23,0	+17,6	+14,0	+11,5	+7,0	+1,5	-3,7	-8,4	-11,4
130	-40	+27,4	+31,0	+31,9	+30,4	+27,0	+24,1	+20,2	+14,4	+5,2	-3,1	-10,1	-14,0
140	-50	+25,3	+30,4	+34,3	+36,2	+36,0	+35,1	+33,0	+26,1	+13,0	-1,5	-11,7	-17,3
150	-60	+21,2	+29,0	+34,2	+38,6	+43,1	+48,2	+50,0	+41,0	+24,0	+3,5	-13,0	-22,0
160	-70	+16,0	+25,1	+32,5	+38,7	+46,9	+58,5	+65,7	+65,0	+51,0	+23,0	-19,0	-38,0
170	-80	+13,8	+24,1	+29,3	+37,7	+49,4	+60,2	+76,0	+96,0	+120,0	+145,0	+175,0	-145,0

TABLE (1) continued

u	λ = φ	180°	195°	210°	225°	240°	255°	270°	285°	300°	315°	330°	345°
10°	+80°	-42,0	-53,0	-67,0	-88,0	-127,0	-180,0	+149,0	+113,0	+94,5	+76,0	+59,0	+39,0
20	+70	-19,2	-28,0	-38,8	-49,0	-64,0	-78,0	+88,0	+82,0	+70,0	+64,0	+49,2	+36,7
30	+60	-12,8	-20,5	-26,5	-34,6	-34,5	-27,0	+ 8,0	+44,0	+32,2	+30,0	+32,3	+30,8
40	+50	-12,0	-17,2	-21,3	-23,8	-23,9	-19,3	-4,0	+18,0	+21,0	+25,3	+33,4	+26,1
50	+40	-11,5	-14,1	-16,0	-17,6	-17,5	-14,7	-6,2	+ 5,9	+18,8	+24,4	+26,0	+24,8
60	+30	-10,4	-11,5	-12,0	-12,4	-12,3	-11,1	-6,3	+ 1,0	+ 9,0	+14,5	+24,3	+19,0
70	+20	- 9,6	- 8,9	- 8,3	- 8,7	- 9,0	- 8,5	-6,1	- 2,0	+ 3,6	+11,0	+19,0	+18,7
80	+10	- 9,0	- 7,6	- 6,1	- 5,5	- 6,2	- 6,9	-6,7	- 4,0	0,0	+ 7,3	+17,4	+19,9
90	0	- 8,7	- 7,4	- 5,0	- 4,5	- 5,3	- 7,1	- 8,7	- 6,3	- 2,0	+ 5,9	+16,8	+22,4
100	-10	- 9,2	- 8,1	- 6,1	- 5,7	- 6,8	- 8,9	-11,1	- 9,1	- 3,9	+ 5,6	+16,2	+23,2
110	-20	- 9,9	- 9,2	- 8,2	- 7,9	- 8,9	-11,0	-13,2	-11,9	- 5,8	+ 4,0	+15,2	+23,5
120	-30	-11,9	-10,8	-10,0	-10,0	-11,1	-13,3	-16,4	-15,2	- 8,2	+ 2,0	+13,1	+22,3
130	-40	-14,3	-13,0	-12,2	-12,3	-13,8	-16,8	-20,6	-18,0	-11,2	- 0,7	+10,7	+20,2
140	-50	-17,4	-15,9	-15,0	-15,7	-18,0	-21,4	-24,2	-21,1	-14,4	- 4,6	+ 6,9	+17,0
150	-60	-22,0	-20,2	-19,5	-20,3	-24,0	-27,2	-29,6	-24,0	-17,7	- 8,0	+ 2,1	+12,2
160	-70	-31,0	-32,0	-35,0	-34,0	-34,3	-34,0	-34,0	-31,0	-21,8	-11,5	- 2,7	+ 4,0
170	-80	-120,0	-103,0	-82,0	-74,0	-62,5	-52,0	-41,5	-32,5	-24,0	-14,5	- 4,6	+ 5,0

Inclination i for 1885 according to the chart

TABLE (2)

u	λ = φ	0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°
0°	+90°	+85,6											
10	+80	+81,3	+81,1	+81,2	+81,6	+82,1	+82,7	+83,7	+84,6	+85,2	+85,7	+85,4	+85,4
20	+70	+76,8	+74,3	+74,3	+74,7	+77,5	+79,0	+80,1	+80,5	+80,2	+80,0	+79,2	+78,6
30	+60	+72,0	+70,8	+70,7	+71,2	+72,0	+73,2	+74,3	+75,6	+74,9	+72,9	+71,2	+70,3
40	+50	+66,2	+64,9	+63,8	+63,9	+64,7	+65,5	+66,4	+67,4	+67,0	+65,5	+63,8	+61,5
50	+40	+58,6	+55,5	+53,7	+53,6	+54,1	+55,0	+56,2	+56,3	+56,7	+55,0	+52,4	+52,0
60	+30	+47,8	+42,7	+39,9	+40,0	+40,2	+41,2	+43,6	+45,8	+44,8	+43,1	+40,2	+40,7
70	+20	+ 30,0	+22,5	+20,0	+20,1	+20,9	+22,0	+24,8	+27,2	+28,4	+27,9	+26,2	+24,4
80	+10	+ 9,7	+ 0,7	- 0,8	- 0,2	0,0	+ 0,5	+ 3,0	+ 6,8	+ 9,0	+10,0	+ 8,6	+10,0
90	0	- 8,7	-19,5	-24,0	-23,4	-22,5	-20,9	-19,5	-15,8	-13,5	-12,3	-11,3	- 8,3
100	-10	-32,4	-34,8	-41,0	-42,0	-42,0	-39,8	-37,6	-34,5	-32,5	-31,7	-30,7	-27,3
110	-20	-35,8	-45,4	-54,5	-54,6	-54,9	-53,6	-52,3	-50,6	-50,0	-49,6	-46,8	-42,8
120	-30	-45,0	-52,0	-57,7	-60,5	-62,5	-62,5	-62,8	-61,9	-62,0	-61,1	-59,5	-56,0
130	-40	-51,2	-56,9	-61,8	-65,2	-67,3	-68,5	-69,0	-69,6	-70,0	-70,0	-68,4	-66,0
140	-50	-56,2	-61,0	-65,1	-68,1	-70,8	-72,4	-74,2	-76,0	-77,4	-77,3	-76,1	-73,5
150	-60	-61,0	-65,0	-67,9	-70,7	-73,0	-75,5	-78,0	-80,3	-82,8	-83,3	-82,0	-79,5
160	-70	-66,3	-68,7	-71,3	-73,5	-75,4	-77,8	-80,2	-82,4	-86,2	-87,8	-88,0	-86,0
170	-80	-72,4	-73,8	-75,0	-76,3	-77,6	-79,4	-81,2	-82,5	-83,8	-85,6	-86,0	-86,2
180	-90	-80,0											

TABLE (2) continued)

α	λ = φ	180°	195°	210°	225°	240°	255°	270°	285°	300°	315°	330°	345°
0°	+90°	+85,6											+85,6
10	+80	+85,4	+84,2	+86,7	+87,3	+87,9	+88,2	+87,0	+85,8	+84,0	+83,3	+82,3	+81,7
20	+70	+78,5	+79,5	+80,9	+82,9	+85,0	+88,8	+86,5	+85,7	+83,0	+80,6	+79,1	+78,7
30	+60	+70,3	+74,7	+76,2	+74,9	+80,2	+83,3	+85,1	+84,2	+81,2	+78,3	+76,8	+72,8
40	+50	+62,4	+66,5	+66,8	+70,1	+73,3	+76,7	+77,6	+79,7	+73,0	+70,7	+74,6	+69,0
50	+40	+53,9	+56,6	+53,0	+66,4	+65,0	+67,9	+70,5	+71,4	+70,2	+68,2	+66,0	+64,1
60	+30	+43,9	+47,3	+49,9	+52,5	+54,6	+57,6	+60,8	+62,1	+61,8	+62,0	+58,6	+56,2
70	+20	+29,5	+35,3	+38,2	+40,2	+41,8	+44,2	+46,9	+49,8	+52,0	+52,7	+49,0	+44,2
80	+10	+10,0	+13,8	+24,7	+28,5	+24,5	+27,0	+30,2	+36,0	+40,0	+44,0	+35,5	+25,8
90	0	−3,9	+0,4	+2,2	+2,5	+3,6	+6,7	+12,8	+17,5	+23,7	+24,3	+20,3	+7,7
100	−10	−22,5	−19,5	−17,4	−15,8	−15,0	−11,0	−6,0	0,0	+6,7	+10,0	+5,0	−6,7
110	−20	−40,0	−36,7	−35,6	−34,8	−32,5	−29,6	−24,0	−18,0	−10,0	−7,2	−18,8	−28,9
120	−30	−53,5	−50,2	−49,0	−46,0	−47,2	−43,0	−37,8	−30,9	−24,6	−28,3	−25,0	−34,2
130	−40	−63,5	−60,5	−59,0	−57,5	−56,1	−53,6	−49,0	−42,1	−35,4	−33,2	−37,4	−44,0
140	−50	−70,8	−68,4	−66,5	−65,4	−63,6	−61,1	−57,0	−51,2	−45,8	−43,5	−46,4	−52,0
150	−60	−77,5	−76,6	−74,5	−73,4	−72,0	−67,7	−64,0	−59,0	−54,5	−53,0	−54,5	−52,3
160	−70	−84,5	−82,7	−81,2	−79,2	−76,6	−73,6	−70,6	−67,7	−63,0	−62,8	−62,9	−66,2
170	−80	−85,8	−84,8	−83,4	−81,7	−80,0	−77,9	−76,1	−74,6	−72,7	−74,7	−71,8	−72,0
180	−90	−80,0											−80,0

Horizontal intensity, τ, for 1885 according to the chart

TABLE (3)

α	λ = φ	0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°
0°	+90°	0,38											0,38
10	+80	0,83	0,83	0,81	0,77	0,70	0,64	0,56	0,49	0,48	0,46	0,47	0,46
20	+70	1,18	1,20	1,20	1,19	1,15	1,09	1,00	0,94	0,95	1,00	1,07	1,13
30	+60	1,56	1,58	1,66	1,69	1,69	1,61	1,56	1,54	1,59	1,66	1,73	1,78
40	+50	1,87	1,97	2,05	2,15	2,19	2,18	2,18	2,18	2,20	2,30	2,34	2,34
50	+40	2,30	2,41	2,56	2,70	2,75	2,84	2,88	2,87	2,84	2,83	2,80	2,70
60	+30	2,68	2,85	3,00	3,18	3,34	3,43	3,45	3,41	3,33	3,20	3,09	2,98
70	+20	2,95	3,11	3,28	3,44	3,61	3,77	3,79	3,70	3,61	3,48	3,34	3,23
80	+10	3,12	3,23	3,315	3,42	3,53	3,70	3,82	3,82	3,79	3,69	3,58	3,50
90	0	2,98	3,08	3,05	3,16	3,30	3,48	3,66	3,80	3,83	3,80	3,74	3,66
100	−10	2,66	2,62	2,64	2,73	2,90	3,13	3,37	3,57	3,685	3,72	3,69	3,66
110	−20	2,34	2,28	2,27	2,33	2,44	2,65	2,85	3,10	3,30	3,42	3,50	3,50
120	−30	2,17	2,07	2,03	2,03	2,09	2,21	2,36	2,52	2,70	2,85	2,92	3,00
130	−40	2,08	1,95	1,875	1,83	1,815	1,86	1,915	1,99	2,07	2,16	2,24	2,40
140	−50	2,07	1,90	1,78	1,71	1,63	1,59	1,54	1,50	1,46	1,49	1,62	1,81
150	−60	2,04	1,84	1,72	1,61	1,49	1,37	1,21	0,99	0,79	0,75	0,91	1,16
160	−70	1,93	1,78	1,66	1,53	1,39	1,20	1,05	0,79	0,45	0,11	0,27	0,50
170	−80	1,68	1,59	1,49	1,40	1,28	1,13	0,99	0,81	0,68	0,49	0,40	0,37
180	−90	1,15											1,15

TABLE (3) continued

u	λ = φ	180°	195°	210°	225°	240°	255°	270°	285°	300°	315°	330°	345°
0	+90°	0,38											0,38
10	+80	0,41	0,40	0,33	0,24	0,15	0,14	0,26	0,43	0,57	0,67	0,76	0,82
20	+70	1,15	1,09	0,93	0,74	0,50	0,18	0,14	0,49	0,75	0,91	1,04	1,12
30	+60	1,79	1,71	1,59	1,35	1,085	0,73	0,44	0,60	0,905	1,13	1,28	1,60
40	+50	2,30	2,23	2,14	1,99	1,77	1,48	1,20	1,15	1,30	1,44	1,58	1,70
50	+40	2,58	2,58	2,50	2,50	2,40	2,24	2,04	1,93	1,82	1,80	1,915	2,30
60	+30	2,85	2,80	2,82	2,91	2,93	2,90	2,83	2,70	2,44	2,30	2,32	2,50
70	+20	3,16	3,12	3,13	3,21	3,345	3,38	3,31	3,15	2,92	2,75	2,72	2,81
80	+10	3,46	3,44	3,405	3,42	3,58	3,63	3,58	3,34	3,06	3,01	2,99	3,01
90	0	3,69	3,62	3,525	3,50	3,54	3,57	3,50	3,31	3,05	2,95	2,96	2,97
100	-10	3,68	3,61	3,50	3,41	3,40	3,35	3,33	3,12	2,905	2,81	2,74	2,70
110	-20	3,48	3,41	3,33	3,23	3,15	3,17	3,09	2,90	2,755	2,63	2,53	2,45
120	-30	3,07	3,01	3,04	2,99	2,95	2,92	2,85	2,83	2,68	2,54	2,40	2,29
130	-40	2,52	2,65	2,68	2,45	2,495	2,75	2,82	2,84	2,73	2,57	2,39	2,23
140	-50	2,00	2,16	2,25	2,31	2,40	2,57	2,72	2,83	2,755	2,64	2,46	2,27
150	-60	1,40	1,60	1,77	1,90	2,09	2,30	2,52	2,69	2,71	2,60	2,42	2,24
160	-70	0,72	0,98	1,20	1,40	1,65	1,90	2,05	2,23	2,30	2,28	2,20	2,07
170	-80	0,44	0,60	0,82	1,00	1,22	1,40	1,56	1,72	1,80	1,80	1,79	1,75
180	-90	1,15											1,15

From this I computed the three components, X, Y, Z of the Earth's magnetism according to the familiar formulas: the northern $x = \tau \cos \delta$, the western $Y = \tau \sin \delta$, and the vertical $Z = \tau_{oty.} i$. For each of the 17 parallel circles, I thus obtained 24 equidistant values of each of the three forces X, Y, Z so that the derivation of the cosine and sine series for them presents no difficulty, especially since I have given the formulas used the following practical form.

Let the periodic functions X, Y or Z have the general form:

$$u^{(0)} + u^{(1)}\sin(U^{(1)}+\lambda) + u^{(2)}\sin(U^{(2)}+2\lambda) + u^{(3)}\sin(U^{(3)}+3\lambda) + u^{(4)}\sin(U^{(4)}+4\lambda) + \ldots$$

or

$$u^{(0)} + [u^{(1)}\sin U^{(1)}]\cos\lambda + [u^{(1)}\cos U^{(1)}]\sin\lambda + [u^{(2)}\sin U^{(2)}]\cos 2\lambda + [u^{(2)}\cos U^{(2)}]\sin 2\lambda + \ldots$$

and let the 24 equidistant, observed values of X, Y or Z be denoted by the numerals 0, 1, 2, 3, 4,..., 22, 23, where 0 belongs to the longitude $\lambda = 0$, 1 to the longitude $\lambda = 15°$, 2 to the longitude $\lambda = 30°$, etc.; then let us compute the constants uu, AA, bb, BB, cc, dd, DD, ee, EE, nn and mm with the help of the given 24 values 0, 1,

2, 3, 4,..., 23 of the functions according to the equations (4):

$$\begin{array}{|l|l|l|l|}
(4-2)-(14-26)=a & (3-7)-(17-19)=b & (1-11)-(13-23)=c & (1-9)-(15-21)=d \\
(4+8)-(16+20)=a_1 & (5+7)-(17+13)=b_1 & (1+11)-(13+23)=c_1 & (3+9)-(15+21)=d_1 \\
(4-8)+(14-20)=A & (7-1)+(19-13)=B & (11-1)+(23-13)=C & (3-9)+(15-21)=D \\
(4+8)+(14+20)=A_1 & (5+7)+(17+19)=B_1 & (11+1)+(23+13)=C_1 & (3+9)+(15+21)=D_1
\end{array}$$

$$\begin{array}{|l|l|}
(2-10)-(14-22)=e \\
(2+10)-(14+22)=e_1 \\
(2-10)+(14-22)=E \\
(2+10)+(14+22)=E_1
\end{array}$$

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$$4-12=k \quad 6+12=n_1 \quad 6-18=m \quad 6+18=m_1$$

Then

$$u^{(0)}=\frac{1}{24}(0+1+2+3+\dots+23),$$

where 1/24 signifies an unnamed number and the parentheses contain the given values of the functions; and the coefficients

$$u^{(1)}\sin\lambda^{(1)},\ u^{(2)}\sin\lambda^{(2)}\dots.$$

of cos λ, cos2λ,..., respectively, as well as the coefficients

$$u^{(1)}\cos\lambda^{(1)},\ u^{(2)}\cos\lambda^{(2)}\dots$$

of sinλ, sin2λ,..., respectively are found by means of the following formulas $(4)_\alpha$:

$$\begin{array}{l}
12u^{(0)}\sin\lambda^{(0)}=n+\frac{1}{2}a+b\sin 15^\circ+c\cos 15^\circ+d\sin 45^\circ+e\sin 60^\circ \\
12u^{(1)}\cos\lambda^{(1)}=m+\frac{1}{2}e+c_1\sin 15^\circ+b_1\cos 15^\circ+d_1\sin 45^\circ+a_1\sin 60^\circ \\
\\
12u^{(2)}\sin\lambda^{(2)}=n_1-m_1+\frac{1}{2}(e_1-A_1)+(b_1-B_1)\sin 60^\circ \\
12u^{(2)}\cos\lambda^{(2)}=D+\frac{1}{2}(E+B)+(A+E)\sin 60^\circ \\
\\
12u^{(3)}\sin\lambda^{(3)}=n-a+(c-b-d)\sin 45^\circ \\
12u^{(3)}\cos\lambda^{(3)}=e_1-m+(d_1+c_1-b_1)\sin 45^\circ \\
\\
12u^{(4)}\sin\lambda^{(4)}=n_1+m_1-D_1+\frac{1}{2}(B_1+E_1-A_1-e_1) \\
12u^{(4)}\cos\lambda^{(4)}=(E+e-A-B)\sin 60^\circ \\
\\
12u^{(5)}\sin\lambda^{(5)}=n+\frac{1}{2}a+c\sin 15^\circ+b\cos 15^\circ-d\sin 45^\circ-e\sin 60^\circ \\
12u^{(5)}\cos\lambda^{(5)}=m+\frac{1}{2}e_1+b_1\sin 15^\circ+c_1\cos 15^\circ-d_1\sin 45^\circ-a_1\sin 60^\circ \\
\\
12u^{(6)}\sin\lambda^{(6)}=n_1-m_1+A_1-e_1 \\
12u^{(6)}\cos\lambda^{(6)}=B+E-D \\
\\
12u^{(7)}\sin\lambda^{(7)}=n+\frac{1}{2}a-c\sin 15^\circ-b\cos 15^\circ+d\sin 45^\circ-e\sin 60^\circ \\
12u^{(7)}\cos\lambda^{(7)}=-(m+\frac{1}{2}e_1)+b_1\sin 15^\circ+c_1\cos 15^\circ-d_1\sin 45^\circ+a_1\sin 60^\circ \\
12u^{(8)}\sin\lambda^{(8)}=n_1+m_1+D_1-\frac{1}{2}(B_1+E_1+d_1+e_1) \\
12u^{(8)}\cos\lambda^{(8)}=(E-e+d-B)\sin 60^\circ
\end{array}$$

$$
\begin{aligned}
12u^{(0)}\sin U^{(0)} &= n - a - (c - b - d)\sin 45^\circ \\
12u^{(0)}\cos U^{(0)} &= -(e_1 - n_1) + (d_1 + c_1 - b_1)\sin 45^\circ \\
12u^{(1)}\sin U^{(1)} &= n_1 - m_1 + \tfrac{1}{2}(e_1 - d_1) - (b_1 - a_1)\sin 60^\circ \\
12u^{(1)}\cos U^{(1)} &= a + \tfrac{1}{2}(b + a) - (d + e)\sin 60^\circ \\
12u^{(2)}\sin U^{(2)} &= n + \tfrac{1}{2}m - b\sin 15^\circ - c\cos 15^\circ - d\sin 45^\circ + e\sin 60^\circ \\
12u^{(2)}\cos U^{(2)} &= -(m + \tfrac{1}{2}e_1) + c_1\sin 15^\circ + b_1\cos 15^\circ + d_1\sin 45^\circ - a_1\sin 60^\circ \\
12u^{(12)}\sin U^{(12)} &= n_1 + m_1 + d_1 - a_1 - b_1 - e_1 + e_1 .
\end{aligned}
$$

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$12u^{(12)}\cos U^{(12)}$ = zero; hence $U^{(12)} = \pm 90$

Herein the numbers 12 and 1/2° are not function values, but unnamed numbers.

With the help of (4) and $(4)_\alpha$, it is easy to find all 24 coefficients of the series

$$
\begin{aligned}
X &= \kappa_0 + \kappa_1\cos\lambda + K_1\sin\lambda + \kappa_2\cos 2\lambda + K_2\sin 2\lambda + \kappa_3\cos 3\lambda + K_3\sin 3\lambda + \cdots \\
Y &= \ell_0 + \ell_1\cos\lambda + \mathcal{L}_1\sin\lambda + \ell_2\cos 2\lambda + \mathcal{L}_2\sin 2\lambda + \ell_3\cos 3\lambda + \mathcal{L}_3\sin 3\lambda + \cdots \\
Z &= m_0 + m_1\cos\lambda + M_1\sin\lambda + m_2\cos 2\lambda + M_2\sin 2\lambda + m_3\cos 3\lambda + M_3\sin 3\lambda + \cdots
\end{aligned}
$$

since the same quantities are frequently repeated. Indeed, the above two series for $U^{(2)}$ and $U^{(3)}$ consist of the same sums as the two series for $U^{(1)}$ and $U^{(0)}$, except that the signs of the terms are occasionally opposite. As is evident from the following tables (5), (6) and (7), I have only computed the development up to $U^{(3)}$ since the higher terms are very small and irregular.

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$$
\begin{vmatrix}
\cdot & \cdot & u^{(0)} \cdot U^{(0)} & \cdot & \cdot & \cdot & \cdot & u^{(0)} \cdot U^{(0)} \\
\cdot & \cdot & u^{(1)} \cdot U^{(1)} & \cdot & \cdot & \cdot & \cdot & u^{(1)} \cdot U^{(1)} \\
\cdot & \cdot & u^{(2)} \cdot U^{(2)} & \cdot & \cdot & \cdot & \cdot & u^{(2)} \cdot U^{(2)} \\
\cdot & \cdot & u^{(3)} \cdot U^{(3)} & \cdot & \cdot & \cdot & \cdot & u^{(3)} \cdot U^{(3)}
\end{vmatrix}
$$

TABLE (5)

u		κ_0	κ_1 (cos λ)	K_1 (sin λ)	κ_2 (cos 2λ)	K_2 (sin 2λ)	κ_3 (cos 3λ)	K_3 (sin 3λ)	κ_4 (cos 4λ)	K_4 (sin 4λ)	κ_5 (cos 5λ)	K_5 (sin 5λ)	κ_6 (cos 6λ)	K_6 (sin 6λ)	κ_7 (cos 7λ)	K_7 (sin 7λ)	u
10	X =	+0,3362	+0,207	+0,328	+0,203	+0,039	+0,015	−0,003	−0,006	−0,016	−0,007	−0,005	+0,000	+0,002	+0,003	+0,000	10°
20	X =	+0,772	+0,022	+0,529	+0,309	+0,055	−0,020	−0,017	+0,002	0,000	−0,002	−0,001	+0,004	+0,002	+0,000	+0,002	20
30	X =	+1,295	−0,157	+0,519	+0,281	+0,113	−0,007	−0,007	−0,015	−0,001	−0,005	+0,005	+0,010	−0,004	+0,003	−0,003	30
40	X =	+1,842	−0,265	+0,516	+0,163	+0,127	+0,012	+0,019	−0,005	−0,010	+0,007	+0,012	+0,005	−0,003	+0,013	−0,001	40
50	X =	+2,394	−0,240	+0,466	−0,045	+0,136	+0,047	+0,048	+0,013	−0,016	+0,024	+0,007	+0,001	−0,021	+0,007	−0,004	50
60	X =	+2,886	−0,170	+0,399	−0,219	+0,136	+0,033	+0,085	+0,031	+0,007	+0,032	+0,002	+0,007	−0,020	−0,001	+0,004	60
70	X =	+3,229	−0,161	+0,303	−0,282	+0,118	+0,014	+0,031	+0,032	+0,004	+0,013	+0,008	+0,005	+0,009	−0,001	−0,006	70
80	X =	+3,400	−0,258	+0,194	−0,230	+0,064	+0,039	+0,059	+0,036	+0,008	−0,017	−0,001	−0,010	+0,023	+0,001	+0,005	80
90	X =	+3,364	−0,419	+0,139	−0,170	−0,018	+0,026	+0,026	+0,024	+0,012	−0,020	−0,012	−0,002	+0,015	+0,000	+0,002	90
100	X =	+3,157	−0,583	+0,069	−0,137	−0,076	+0,014	0,000	+0,014	+0,013	−0,020	−0,011	−0,004	+0,017	+0,000	+0,004	100
110	X =	+2,860	−0,691	−0,062	−0,075	−0,137	−0,002	+0,002	−0,014	−0,005	−0,012	−0,007	−0,006	+0,012	+0,005	+0,004	110
120	X =	+2,524	−0,511	−0,255	−0,016	−0,130	−0,023	−0,028	−0,022	+0,005	−0,006	−0,009	+0,004	+0,008	−0,005	−0,003	120
130	X =	+2,211	−0,264	−0,574	−0,061	−0,125	−0,038	−0,050	−0,022	+0,020	0,000	−0,007	+0,001	+0,005	+0,000	−0,003	130
140	X =	+1,915	+0,043	−0,654	−0,007	−0,129	−0,059	−0,060	−0,019	+0,018	−0,002	−0,008	+0,006	+0,003	+0,001	−0,004	140
150	X =	+1,572	+0,371	−0,771	+0,041	−0,077	−0,073	−0,062	−0,024	+0,010	−0,007	−0,002	+0,011	−0,006	+0,008	−0,005	150
160	X =	+1,169	+0,680	−0,674	+0,060	−0,017	−0,033	−0,048	−0,025	+0,025	−0,023	−0,002	+0,016	−0,013	+0,017	+0,002	160
170	X =	[illegible]	+0,932	−0,474	+0,001	+0,005	−0,066	+0,006	+0,073	−0,011	+0,002	+0,009	−0,001	−0,002	−0,002	−0,005	170
	ρ		±0,352	0,394	0,136	0,089	0,031	0,036	0,019	0,010	0,012	0,006	0,006	0,010	0,004	0,004	ρ

TABLE (6)

u		ℓ_0	ℓ_1 (cos λ)	$\mathcal{L}_1$ (sin λ)	ℓ_2 (cos 2λ)	$\mathcal{L}_2$ (sin 2λ)	ℓ_3 (cos 3λ)	$\mathcal{L}_3$ (sin 3λ)	ℓ_4 (cos 4λ)	$\mathcal{L}_4$ (sin 4λ)	ℓ_5 (cos 5λ)	$\mathcal{L}_5$ (sin 5λ)	ℓ_6 (cos 6λ)	$\mathcal{L}_6$ (sin 6λ)	ℓ_7 (cos 7λ)	$\mathcal{L}_7$ (sin 7λ)	u
10°	y =	−0,006	+0,332	−0,262	+0,043	−0,158	−0,009	−0,011	−0,013	+0,001	+0,001	+0,005	+0,010	−0,002	−0,002	−0,002	10°
20	y =	−0,020	+0,422	−0,219	+0,068	−0,383	−0,012	+0,029	−0,008	+0,016	+0,002	+0,000	+0,000	−0,008	+0,002	+0,001	20
30	y =	−0,004	+0,440	−0,119	+0,105	−0,493	+0,010	+0,054	−0,030	+0,016	+0,006	−0,001	−0,011	+0,000	+0,005	+0,002	30
40	y =	−0,010	+0,473	−0,030	+0,124	−0,519	±0,025	+0,063	−0,062	+0,030	+0,016	−0,012	−0,008	+0,014	−0,007	−0,007	40
50	y =	−0,014	+0,493	+0,023	+0,160	−0,450	+0,041	+0,036	−0,081	+0,039	+0,030	−0,023	−0,002	+0,005	−0,003	−0,005	50
60	y =	−0,009	+0,516	+0,056	+0,182	−0,334	+0,055	−0,006	−0,087	+0,016	+0,026	−0,033	−0,002	+0,010	−0,011	+0,003	60
70	y =	+0,003	+0,541	+0,063	+0,215	−0,210	+0,031	−0,051	−0,073	−0,015	+0,023	−0,042	−0,013	+0,012	−0,016	−0,002	70
80	y =	+0,013	+0,569	+0,073	+0,248	−0,097	+0,142	−0,085	−0,058	−0,047	+0,028	−0,045	−0,017	+0,002	−0,023	−0,007	80

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TABLE (7)

u	m_0	cos λ m_1	sin λ M_1	cos 2λ m_2	sin 2λ M_2	cos 3λ m_3	sin 3λ M_3	cos 4λ m_4	sin 4λ M_4	cos 5λ m_5	sin 5λ M_5	cos 6λ m_6	sin 6λ M_6	cos 7λ m_7	sin 7λ M_7
10	Z=+5,376	−0,037	+0,097	+0,329	−0,390	−0,161	−0,046	−0,078	+0,207	+0,174	−0,151	−0,112	−0,029	−0,009	+0,021
20	Z=+5,359	−0,239	−0,235	−0,225	−0,098	−0,098	−0,010	+0,017	+0,063	+0,096	+0,074	+0,015	−0,017	−0,001	−0,106
30	Z=+5,340	−0,258	−0,282	−0,457	+0,020	+0,065	−0,105	−0,210	+0,004	−0,015	+0,066	+0,031	+0,006	+0,016	−0,094
40	Z=+5,019	−0,386	−0,395	−0,519	−0,078	+0,109	+0,079	+0,013	+0,061	+0,015	−0,074	−0,005	+0,004	−0,013	+0,025
50	Z=+4,300	+0,011	−0,650	−0,726	−0,136	+0,072	+0,036	+0,036	+0,009	+0,018	−0,045	+0,015	−0,007	+0,007	−0,011
60	Z=+3,457	+0,166	−0,863	−0,696	−0,242	+0,010	−0,071	+0,034	+0,073	+0,015	−0,050	+0,020	−0,028	−0,019	−0,007
70	Z=+2,281	+0,020	−1,024	−0,523	−0,357	−0,069	−0,164	−0,073	+0,034	−0,037	−0,051	−0,010	+0,007	−0,003	−0,012
80	Z=+1,053	+0,005	−1,096	−0,211	−0,431	−0,113	−0,196	−0,115	+0,030	−0,053	−0,061	−0,003	0,000	−0,007	−0,018
90	Z=−0,231	+0,078	−1,167	−0,036	−0,516	−0,150	−0,225	−0,079	−0,002	−0,034	−0,052	0,000	+0,007	+0,005	+0,010
100	Z=−1,362	+0,337	−1,307	+0,064	−0,520	−0,092	−0,232	−0,034	−0,001	−0,027	−0,034	+0,013	−0,007	+0,001	+0,008
110	Z=−2,412	+0,759	−1,305	+0,136	−0,321	−0,123	−0,235	+0,013	+0,004	−0,022	+0,007	−0,002	−0,001	−0,006	−0,006
120	Z=−3,253	+1,167	−1,343	+0,135	−0,219	−0,173	−0,232	+0,029	+0,035	−0,030	+0,028	−0,011	−0,003	+0,017	+0,015
130	Z=−3,945	+1,395	−1,131	+0,155	−0,161	−0,161	−0,197	−0,013	+0,047	−0,013	+0,059	+0,004	−0,008	+0,014	0,000
140	Z=−4,623	+1,557	−0,919	+0,209	−0,015	−0,197	−0,307	−0,001	+0,028	−0,005	+0,070	+0,001	+0,009	−0,005	−0,008
150	Z=−5,216	+1,507	−0,335	+0,214	−0,275	−0,202	−0,037	+0,003	+0,009	+0,007	−0,004	0,000	+0,023	+0,012	+0,033
160	Z=−6,023	+1,675	−0,127	+0,027	−0,175	−0,108	−0,034	+0,036	−0,020	−0,034	+0,026	+0,071	+0,024	−0,073	+0,063
170	Z=−6,040	+0,588	+0,167	+0,298	−0,277	−0,140	+0,144	+0,060	−0,124	−0,066	+0,077	+0,037	−0,041	+0,053	+0,077
σ		±0,164	0,149	0,294	0,240	0,113	0,124	0,081	0,050	0,033	0,054	0,028	0,013	0,018	0,030

Subpl (6)

u	l_0	cos λ l_1	sin λ L_1	cos 2λ l_2	sin 2λ L_2	cos 3λ l_3	sin 3λ L_3	cos 4λ l_4	sin 4λ L_4	cos 5λ l_5	sin 5λ L_5	cos 6λ l_6	sin 6λ L_6	cos 7λ l_7	sin 7λ L_7
90°	Y=+0,015	+0,580	+0,413	+0,263	−0,023	+0,169	−0,117	−0,082	−0,056	+0,058	−0,034	−0,010	−0,008	−0,012	−0,013
100	Y=+0,007	+0,637	+0,413	+0,298	+0,018	+0,169	−0,129	−0,039	−0,048	+0,014	−0,023	−0,002	−0,005	−0,008	−0,012
110	Y=+0,007	+0,667	+0,333	+0,225	+0,048	+0,158	−0,131	−0,019	−0,029	−0,008	−0,010	0,000	−0,001	−0,003	−0,011
120	Y=+0,025	+0,617	+0,490	+0,184	+0,097	+0,152	−0,135	−0,016	−0,017	−0,022	+0,003	0,000	+0,007	+0,002	−0,009
130	Y=+0,011	+0,670	+0,642	+0,152	+0,130	+0,139	−0,151	−0,020	−0,020	−0,026	+0,008	0,000	+0,005	+0,006	−0,008
140	Y=+0,022	+0,625	+0,797	+0,134	+0,150	+0,133	−0,165	−0,017	−0,015	−0,022	+0,007	+0,009	−0,001	+0,007	−0,005
150	Y=−0,015	+0,538	+0,900	+0,137	+0,171	+0,094	−0,151	−0,014	−0,027	−0,003	+0,021	−0,005	+0,013	+0,006	−0,012
160	Y=−0,030	+0,461	+0,946	+0,097	+0,142	+0,045	−0,109	+0,006	−0,025	−0,010	+0,037	−0,006	−0,005	+0,008	−0,006
170	Y=−0,044	+0,391	+0,937	+0,025	+0,012	+0,011	−0,048	+0,026	+0,005	−0,005	−0,006	+0,003	+0,002	−0,002	+0,004
σ	±0,017	0,533	0,367	0,154	0,104	0,086	0,027	0,037	0,025	0,016	0,012	0,006	0,005	0,002	0,006

The averages ζ of all 17 parallel circles are taken without regard for the signs--the vertical number rows /9

$$c_0 \dots c_7, \; k_1 \dots k_8, \; l_1 \dots l_8, \; \gamma_1 \dots \gamma_8, \; m_2 \dots m_8, \; M_1 \dots M_8$$

of the foregoing three tables (5), (6), (7) are functions of the latitude, ϕ, or of the angular distance, u, from the astronomical North Pole, and it is above all a question of finding the analytical expression for it. According to Gauss (cf. GWV, pp 142-143), the potential U, divided by the radius of the Earth, R, is

$$\frac{V}{R} = \mathcal{P}' + \mathcal{P}'' + \mathcal{P}''' + \mathcal{P}^{IV} + \mathcal{P}^{V} + \mathcal{P}^{VI} + \mathcal{P}^{VII} + \dots$$

and the rule given by him on page 142 for expanding the quantities $\mathcal{P}$, leads to the following expressions for them, which except for u and the longitude, λ, (east of Greenwich) and 63 numerical coefficients of the theory to be determined--

$$g^{1,0} g^{2,0} \dots g^{7,0} : g^{1,1} g^{2,1} \dots g^{7,1} ; \; h^{1,1} h^{2,1} \dots h^{7,1} \qquad /10$$

etc.--contain formulas (8):

$$\mathcal{P}' = g^{1,0} \cos u + (g^{1,1} \cos\lambda + h^{1,1} \sin\lambda) \sin u,$$

$$\mathcal{P}'' = g^{2,0} (\cos u^2 - \tfrac{1}{3}) + (g^{2,1} \cos\lambda + h^{2,1} \sin\lambda) \cos u \sin u + (g^{2,2} \cos 2\lambda + h^{2,2} \sin 2\lambda) \sin u^2,$$

$$\mathcal{P}''' = g^{3,0} (\cos u^3 - \tfrac{3}{5} \cos u) + (g^{3,1} \cos\lambda + h^{3,1} \sin\lambda)(\cos u^2 - \tfrac{1}{5}) \sin u + (g^{3,2} \cos 2\lambda + h^{3,2} \sin 2\lambda) \cos u \sin u^2 + (g^{3,3} \cos 3\lambda + h^{3,3} \sin 3\lambda) \sin u^3,$$

$$\mathcal{P}^{IV} = g^{4,0} (\cos u^4 - \tfrac{6}{7} \cos u^2 + \tfrac{3}{35}) + (g^{4,1} \cos\lambda + h^{4,1} \sin\lambda)(\cos u^3 - \tfrac{3}{5} \cos u) \sin u + (g^{4,2} \cos 2\lambda + h^{4,2} \sin 2\lambda)(\cos u^2 - \tfrac{1}{7}) \sin u^2 + (g^{4,3} \cos 3\lambda + h^{4,3} \sin 3\lambda) \cos u \sin u^3 + (g^{4,4} \cos 4\lambda + h^{4,4} \sin 4\lambda) \sin u^4,$$

$$\mathcal{P}^{V} = g^{5,0} (\cos u^5 - \tfrac{10}{9} \cos u^3 + \tfrac{5}{21} \cos u) + (g^{5,1} \cos\lambda + h^{5,1} \sin\lambda)(\cos u^4 - \tfrac{3}{4} \cos u^2 + \tfrac{1}{28}) \sin u + (g^{5,2} \cos 2\lambda + h^{5,2} \sin 2\lambda)(\cos u^3 - \tfrac{1}{3} \cos u) \sin u^2 + (g^{5,3} \cos 3\lambda + h^{5,3} \sin 3\lambda)(\cos u^2 - \tfrac{1}{9}) \sin u^3 + (g^{5,4} \cos 4\lambda + h^{5,4} \sin 4\lambda) \cos u \sin u^4 + (g^{5,5} \cos 5\lambda + h^{5,5} \sin 5\lambda) \sin u^5,$$

$$\mathcal{P}^{VI} = g^{6,0} (\cos u^6 - \tfrac{15}{11} \cos u^4 + \tfrac{5}{11} \cos u^2 - \tfrac{5}{231}) + (g^{6,1} \cos\lambda + h^{6,1} \sin\lambda)(\cos u^5 - \tfrac{10}{11} \cos u^3 + \tfrac{5}{33} \cos u) \sin u + (g^{6,2} \cos 2\lambda + h^{6,2} \sin 2\lambda)(\cos u^4 - \tfrac{6}{11} \cos u^2 + \tfrac{1}{33}) \sin u^2 + (g^{6,3} \cos 3\lambda + h^{6,3} \sin 3\lambda)(\cos u^3 - \tfrac{3}{11} \cos u) \sin u^3 + (g^{6,4} \cos 4\lambda + h^{6,4} \sin 4\lambda)(\cos u^2 - \tfrac{1}{11}) \sin u^4 + (g^{6,5} \cos 5\lambda + h^{6,5} \sin 5\lambda) \cos u \sin u^5 + (g^{6,6} \cos 6\lambda + h^{6,6} \sin 6\lambda) \sin u^6,$$

$$\mathcal{P}^{VII} = g^{7,0} (\cos u^7 - \tfrac{21}{13} \cos u^5 + \tfrac{105}{143} \cos u^3 - \tfrac{35}{429} \cos u) + (g^{7,1} \cos\lambda + h^{7,1} \sin\lambda)(\cos u^6 - \tfrac{15}{13} \cos u^4 + \tfrac{45}{143} \cos u^2 - \tfrac{5}{143}) \sin u + (g^{7,2} \cos 2\lambda + h^{7,2} \sin 2\lambda)(\cos u^5 - \tfrac{10}{13} \cos u^3 + \tfrac{15}{143} \cos u) \sin u^2 + (g^{7,3} \cos 3\lambda + h^{7,3} \sin 3\lambda)(\cos u^4 - \tfrac{4}{13} \cos u^2 + \tfrac{1}{143}) \sin u^3 + (g^{7,4} \cos 4\lambda + h^{7,4} \sin 4\lambda)(\cos u^3 - \tfrac{3}{13} \cos u) \sin u^4 + (g^{7,5} \cos 5\lambda + h^{7,5} \sin 5\lambda)(\cos u^2 - \tfrac{1}{13}) \sin u^5 + (g^{7,6} \cos 6\lambda + h^{7,6} \sin 6\lambda) \cos u \sin u^6 + (g^{7,7} \cos 7\lambda + h^{7,7} \sin 7\lambda) \sin u^7.$$

Furthermore, according to Gauss, we have formula (9):

$$X = -\left(\frac{dT'}{du} + \frac{dT''}{du} + \frac{dT'''}{du} + \frac{dT^{IV}}{du} + \frac{dT^{V}}{du} + \frac{dT^{VI}}{du} + \frac{dT^{VII}}{du} + \ldots\right)$$

$$Y = -\frac{1}{\sin u}\left(\frac{dT'}{d\lambda} + \frac{dT''}{d\lambda} + \frac{dT'''}{d\lambda} + \frac{dT^{IV}}{d\lambda} + \frac{dT^{V}}{d\lambda} + \frac{dT^{VI}}{d\lambda} + \frac{dT^{VII}}{d\lambda} + \ldots\right)$$

$$Z = 2T' + 3T'' + 4T''' + 5T^{IV} + 6T^{V} + 7T^{VI} + 8T^{VII} + \ldots$$

In order to obtain the analytical expressions for the coefficients of the above tables (5), (6) and (7), we must, according to formulas (9), differentiate the formulas (8) with respect to u and λ, and form the sum for Z. In the formulas for (X), (Y) and (Z) thus obtained, I have for brevity set cosu = e, and sinu = f, and for the following functions, which depend only on even powers of the quantity e, I have used simple signs, the letters $\mathfrak{A}\ \mathfrak{B}\ \mathfrak{C}\ \mathfrak{D}\ \mathfrak{E}\ \mathfrak{F}$ etc., namely: /11

Formulas (10).

$$e^2 - 0,2 = \mathfrak{A} \qquad e^2 - 0,4286 = \mathfrak{B} \qquad e^2 - 0,3333 = \mathfrak{C} \qquad e^2 - 0,1429 = \mathfrak{D} \qquad e^2 - 0,1111 = \mathfrak{E}$$

$$e^2 - 0,2727 = \mathfrak{F} \qquad e^2 - 0,2308 = \mathfrak{G} \qquad e^2 - 0,0909 = \mathfrak{H} \qquad e^2 - 0,0769 = \mathfrak{I}$$

$$e^4 - \underline{2,85391}^{-10} \cdot e^2 + 0,0476 = \mathfrak{A}_1$$

$$e^4 - \underline{9,95161}^{-10} \cdot e^2 + 0,1515 = \mathfrak{B}_1$$

$$e^4 - \underline{9,73676}^{-10} \cdot e^2 + 0,0303 = \mathfrak{C}_1$$

$$e^4 - \underline{9,88606}^{-10} \cdot e^2 + 0,1049 = \mathfrak{D}_1$$

$$e^4 - \underline{9,66421}^{-10} \cdot e^2 + 0,0210 = \mathfrak{E}_1$$

$$e^6 - \underline{0,062315}\, e^4 + \underline{9,97787}^{-10} \cdot e^2 - 0,0117 = \mathfrak{A}_{II}$$

$$e^2 - 0,5 = \mathfrak{A}_0 \qquad e^2 - 0,7333 = \mathfrak{B}_0$$

$$e^4 - \underline{9,88458}^{-10}\, e^2 + 0,1071 = \mathfrak{C}_0$$

$$e^4 - \underline{0,07918}\, e^2 + 0,2762 = \mathfrak{D}_0$$

$$e^6 - \underline{0,15118}\, e^4 + \underline{9,70333}^{-10}\, e^2 - 0,0282 = \mathfrak{E}_0$$

$$e^6 - \underline{0,22565}\, e^4 + \underline{9,82223}^{-10}\, e^2 - 0,0046 = \mathfrak{F}_0$$

$$e^2 - 0,5714 = \mathfrak{G}_0$$

$$e^4 - \underline{9,90103}^{-10}\, e^2 + 0,0467 = \mathfrak{H}_0$$

$$e^4 - \underline{0,013332}\, e^2 + 0,1919 = \mathfrak{I}_0$$

$$e^6 - \underline{0,10166}\, e^4 + \underline{9,57360}^{-10}\, e^2 - 0,0150 = \mathfrak{K}_0$$

$$e^2 - 0,25 = \mathfrak{L}_0 \qquad e^2 - 0,4667 = \mathfrak{M}_0$$

$$e^4 - \underline{9,81367}^{-10}\, e^2 + 0,0455 = \mathfrak{N}_0$$

$$e^4 - \underline{9,95477}^{-10}\, e^2 + 0,1409 = \mathfrak{O}_0$$

$$e^2 - 0,3939 = \mathfrak{A}'_0$$

$$e^4 - \underline{9,77335}^{-10} \cdot e^2 + 0,033 = \mathfrak{B}'_0$$

$$e^2 - 0,1667 = \mathfrak{C}'_0 \qquad e^2 - 0,5407 = \mathfrak{D}'_0$$

$$e^2 - 0,6 = \mathfrak{E}'_0$$

$$e^4 - \underline{9,91305}^{-10}\, e^2 + 0,0857 = \mathfrak{F}'_0$$

$$e^4 - \underline{0,04576}\, e^2 + 0,2381 = \mathfrak{G}'_0$$

$$e^6 - \underline{0,11532}\, e^4 + \underline{9,65725}^{-10}\, e^2 - 0,0216 = \mathfrak{H}'_0$$

$$e^6 - \underline{0,20132}\, e^4 + \underline{9,86545}^{-10}\, e^2 - 0,0816 = \mathfrak{I}'_0$$

Formulas (X)

$$k_1 = g^{11}f + g^{12}ef + g^{13}f^2 + g^{14}e^2f + g^{15}ef^2 + g^{16}f^3 + g^{17}e^3f + g^{18}ef^3 + g^{19}f^4.$$

$$-k_1 = g^{11}e + g^{12}d + g^{13}e^2 + g^{14}ef + g^{15}f^2 + g^{16}e^3 + g^{17}e^2f + g^{18}ef^2 + g^{19}f^3$$

$$-k_1 = g^{11}e^2f + g^{12}ef^2 + g^{13}f^3 + g^{14}e^3f + g^{15}e^2f^2 + g^{16}ef^3 + g^{17}f^4 + g^{18}e^4f + g^{19}e^3f^2$$

$$-k_1 = g^{11}e^3f + g^{12}e^2f^2 + g^{13}ef^3 + g^{14}f^4 + g^{15}e^4f + g^{16}e^3f^2 + g^{17}e^2f^3 + g^{18}ef^4 + g^{19}f^5$$

$$-k_1 = g^{11}e^4f + g^{12}e^3f^2 + g^{13}e^2f^3 + g^{14}ef^4 + g^{15}f^5 + g^{16}e^5f + g^{17}e^4f^2 + g^{18}e^3f^3 + g^{19}e^2f^4$$

$$-k_1 = g^{11}e^5f + g^{12}e^4f^2 + g^{13}e^3f^3 + g^{14}e^2f^4 + g^{15}ef^5 + g^{16}f^6 + g^{17}e^6f + g^{18}e^5f^2 + g^{19}e^4f^3$$

$$-k_1 = g^{11}e^6f + g^{12}e^5f^2 + g^{13}e^4f^3 + g^{14}e^3f^4 + g^{15}e^2f^5 + g^{16}ef^6 + g^{17}f^7 + g^{18}e^7f + g^{19}e^6f^2$$

$$-k_1 = g^{11}e^7f + g^{12}e^6f^2 + g^{13}e^5f^3 + g^{14}e^4f^4 + g^{15}e^3f^5 + g^{16}e^2f^6 + g^{17}ef^7 + g^{18}f^8 + g^{19}e^8f$$

$$-k_1 = g^{11}e^8f + g^{12}e^7f^2 + g^{13}e^6f^3 + g^{14}e^5f^4 + g^{15}e^4f^5 + g^{16}e^3f^6 + g^{17}e^2f^7 + g^{18}ef^8 + g^{19}f^9$$

$$-k_1 = g^{11}e^9f + g^{12}e^8f^2 + g^{13}e^7f^3 + g^{14}e^6f^4 + g^{15}e^5f^5 + g^{16}e^4f^6 + g^{17}e^3f^7 + g^{18}e^2f^8 + g^{19}ef^9$$

$$-k_1 = g^{11}e^{10}f + g^{12}e^9f^2 + g^{13}e^8f^3 + g^{14}e^7f^4 + g^{15}e^6f^5 + g^{16}e^5f^6 + g^{17}e^4f^7 + g^{18}e^3f^8 + g^{19}e^2f^9$$

For the coefficients K_1, K_2, K_3 ... of sinλ, sin2 λ, sinλ ... respectively, the formulas (X) hold also, but with the difference only that the symbol "g" is replaced by the symbol "h" and instead of the numerical values k_1, k_2, k_3..., the numbers K_1, K_2, K_3 given in Table (5) must be used, so that

$$-K_1 = h^{11}e + h^{12}d + h^{13}e^2 + h^{14}ef + h^{15}f^2 + h^{16}e^3 + h^{17}e^2f + h^{18}ef^2 + h^{19}f^3$$

$$-K_2 = h^{21}ef + h^{22}f^2 + h^{23}e^2f + h^{24}ef^2 + h^{25}f^3 + h^{26}e^3f + h^{27}e^2f^2 + h^{28}ef^3 + h^{29}f^4$$

etc. etc.

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Formulas (Y)

$$L_1 = g^{11} + g^{21}e + g^{31}d + g^{41}e^2 + g^{51}ef + g^{61}f^2 + g^{71}e^3 + g^{81}e^2f + g^{91}ef^2$$

$$L_2 = g^{12} + g^{22}e + g^{32}d + g^{42}e^2 + g^{52}ef + g^{62}f^2 + g^{72}e^3 + g^{82}e^2f + g^{92}ef^2$$

$$L_3 = g^{13} + g^{23}e + g^{33}d + g^{43}e^2 + g^{53}ef + g^{63}f^2 + g^{73}e^3 + g^{83}e^2f + g^{93}ef^2$$

$$L_4 = g^{14} + g^{24}e + g^{34}d + g^{44}e^2 + g^{54}ef + g^{64}f^2 + g^{74}e^3 + g^{84}e^2f + g^{94}ef^2$$

$$L_5 = g^{15} + g^{25}e + g^{35}d + g^{45}e^2 + g^{55}ef + g^{65}f^2 + g^{75}e^3 + g^{85}e^2f + g^{95}ef^2$$

$$L_6 = g^{16} + g^{26}e + g^{36}d + g^{46}e^2 + g^{56}ef + g^{66}f^2 + g^{76}e^3 + g^{86}e^2f + g^{96}ef^2$$

$$L_7 = g^{17} + g^{27}e + g^{37}d + g^{47}e^2 + g^{57}ef + g^{67}f^2 + g^{77}e^3 + g^{87}e^2f + g^{97}ef^2$$

$$L_8 = g^{18} + g^{28}e + g^{38}d + g^{48}e^2 + g^{58}ef + g^{68}f^2 + g^{78}e^3 + g^{88}e^2f + g^{98}ef^2$$

$$L_9 = g^{19} + g^{29}e + g^{39}d + g^{49}e^2 + g^{59}ef + g^{69}f^2 + g^{79}e^3 + g^{89}e^2f + g^{99}ef^2$$

NOTE: The underlined numbers of formulas (10) are logarithms which are used instead of the corresponding numbers.

The equations for $l, l_1 l_2 \ldots l_7$ are obtained from the corresponding equations for $k, k_1 k_2 \ldots k_7$, by putting $-l, -l_1 - l_2 \ldots - l_7$ in place respectively of $k, k_1 k_2 \ldots k_7$ and replacing g by h, so that

$$-l_0 = h^{00} k_0 + h^{01} k_1 + h^{02} k_2 + h^{03} k_3 + h^{04} k_4 + h^{05} k_5 + h^{06} k_6 + h^{07} k_7$$

$$-l_1 = h^{10} k_0 + h^{11} k_1 + h^{12} k_2 + h^{13} k_3 + h^{14} k_4 + h^{15} k_5 + h^{16} k_6 + h^{17} k_7,$$

etc. etc.

Formulas (Z)

$$m_0 = g^{00} k_0 + g^{01} k_1 + g^{02} k_2 + g^{03} k_3 + g^{04} k_4 + g^{05} k_5 + g^{06} k_6 + g^{07} k_7$$

$$m_1 = g^{10} k_0 + g^{11} k_1 + g^{12} k_2 + g^{13} k_3 + g^{14} k_4 + g^{15} k_5 + g^{16} k_6 + g^{17} k_7$$

$$m_2 = g^{20} k_0 + g^{21} k_1 + g^{22} k_2 + g^{23} k_3 + g^{24} k_4 + g^{25} k_5 + g^{26} k_6 + g^{27} k_7$$

$$m_3 = g^{30} k_0 + g^{31} k_1 + g^{32} k_2 + g^{33} k_3 + g^{34} k_4 + g^{35} k_5 + g^{36} k_6 + g^{37} k_7$$

$$m_4 = g^{40} k_0 + g^{41} k_1 + g^{42} k_2 + g^{43} k_3 + g^{44} k_4 + g^{45} k_5 + g^{46} k_6 + g^{47} k_7$$

$$m_5 = g^{50} k_0 + g^{51} k_1 + g^{52} k_2 + g^{53} k_3 + g^{54} k_4 + g^{55} k_5 + g^{56} k_6 + g^{57} k_7$$

$$m_6 = g^{60} k_0 + g^{61} k_1 + g^{62} k_2 + g^{63} k_3 + g^{64} k_4 + g^{65} k_5 + g^{66} k_6 + g^{67} k_7$$

$$m_7 = g^{70} k_0 + g^{71} k_1 + g^{72} k_2 + g^{73} k_3 + g^{74} k_4 + g^{75} k_5 + g^{76} k_6 + g^{77} k_7$$

Since the same formulas hold for $M, M_1 \ldots M_7$ as for those just mentioned (Z) for $m, m_1 \ldots m_7$, respectively, it is only necessary to replace g by h and to apply the numerical values $M, M_1 \ldots M_7$ of Table ( ) when h is to be computed. Since in the first terms of the τ, formulas (8), no λ appears, so the following two groups $(X)_0$ and $(Z)_0$ remain for determining $g^{00} g^{10} g^{20} g^{30} g^{40} g^{50} g^{60} g^{70}$

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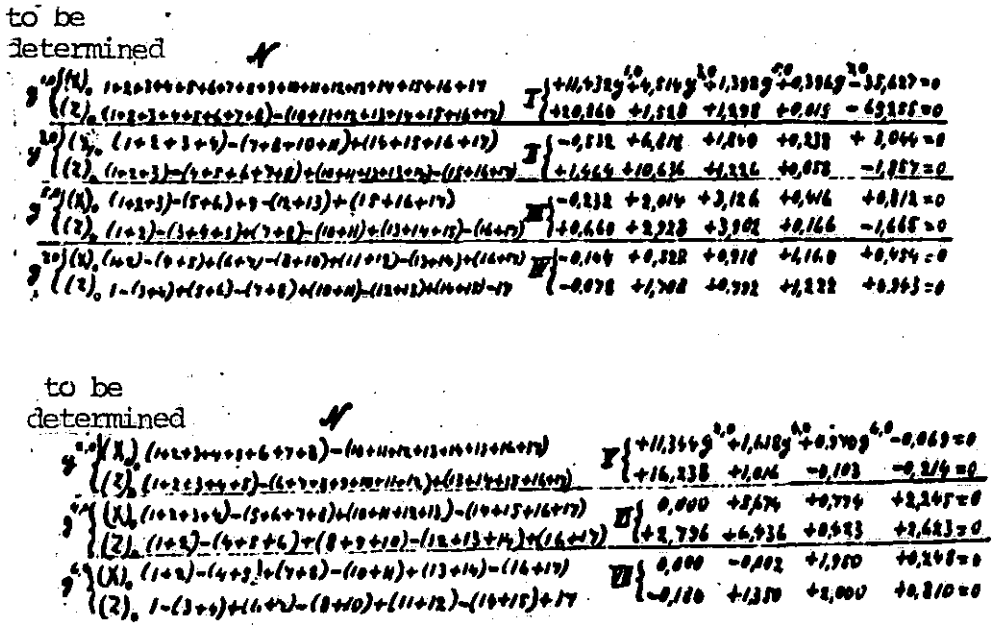
Primitive equations (Y).

Eq. No.	u	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
1	10°	+0,174 g	+0,342 g	+0,401 g	+0,370 g	+0,297 g	+0,216 g	+0,167 g	-0,842 = 0
2	20	+0,342	+0,643	+0,701	+0,584	+0,408	+0,248	+0,131	-0,772 = 0
3	30	+0,500	+0,866	+0,825	+0,557	+0,275	+0,083	-0,009	-1,208 = 0
4	40	+0,643	+0,985	+0,746	+0,312	+0,002	-0,111	-0,100	-1,808 = 0
5	50	+0,766	+0,985	+0,490	-0,031	-0,219	-0,158	-0,044	-2,394 = 0
6	60	+0,866	+0,866	+0,130	-0,309	-0,245	-0,035	+0,064	-2,886 = 0
7	70	+0,940	+0,643	-0,234	-0,401	-0,078	+0,114	+0,072	-3,229 = 0
8	80	+0,985	+0,342	-0,502	-0,273	+0,140	+0,128	-0,022	-3,400 = 0
9	90	+1,000	0,000	-0,600	0,000	+0,238	0,000	-0,082	-3,364 = 0
10	100	+0,985	-0,342	-0,502	+0,273	+0,140	-0,128	-0,022	-3,187 = 0
11	110	+0,940	-0,643	-0,234	+0,401	-0,078	-0,114	+0,072	-2,860 = 0
12	120	+0,866	-0,866	+0,130	+0,309	-0,245	+0,035	+0,064	-2,524 = 0
13	130	+0,766	-0,985	+0,490	+0,031	-0,219	+0,158	-0,044	-2,211 = 0
14	140	+0,643	-0,985	+0,746	-0,312	+0,002	+0,111	-0,100	-1,915 = 0
15	150	+0,500	-0,866	+0,825	-0,557	+0,275	-0,083	-0,009	-1,572 = 0
16	160	+0,342	-0,643	+0,701	-0,584	+0,408	-0,248	+0,131	-1,169 = 0
17	170	+0,174	-0,342	+0,401	-0,370	+0,297	-0,216	+0,167	-0,689 = 0

Primitive equations (Z).

Eq. no.	u	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$-m_0$
1	10	+1,970 g	+1,910 g	+1,457 g	+0,975 g	+0,595 g	+0,340 g	+0,178 g	-5,376 = 0
2	20	+1,879	+1,649	+1,064	+0,543	+0,207	+0,038	-0,036	-5,559 = 0
3	30	+1,732	+1,250	+0,520	+0,026	-0,171	-0,181	-0,123	-5,340 = 0
4	40	+1,532	+0,761	-0,040	-0,364	-0,320	-0,157	-0,031	-5,015 = 0
5	50	+1,286	+0,240	-0,480	-0,488	-0,194	+0,027	+0,084	-4,300 = 0
6	60	+1,000	-0,250	-0,700	-0,330	+0,068	+0,157	+0,066	-3,457 = 0
7	70	+0,684	-0,649	-0,661	-0,004	+0,250	+0,101	-0,044	-2,281 = 0
8	80	+0,347	-0,910	-0,396	+0,304	+0,214	-0,064	-0,085	-1,053 = 0
9	90	0,000	-1,000	0.000	+0,428	0.000	-0,151	0.000	+0,231 = 0
10	100	-0,347	-0,910	+0,396	+0,304	-0,214	-0,064	+0,085	+1,362 = 0
11	110	-0,684	-0,649	+0,661	-0,004	-0,250	+0,101	+0,044	+2,412 = 0
12	120	-1,000	-0,250	+0,700	-0,330	-0,068	+0,157	-0,066	+3,253 = 0
13	130	-1,286	+0,240	+0,480	-0,488	+0,194	+0,027	-0,084	+3,945 = 0
14	140	-1,532	+0,761	+0,040	-0,364	+0,320	-0,157	+0,031	+4,623 = 0
15	150	-1,732	+1,250	-0,520	+0,026	+0,171	-0,181	+0,123	+5,216 = 0
16	160	-1,879	+1,649	-1,064	+0,543	-0,207	+0,038	+0,036	+6,027 = 0
17	170	-1,970	+1,910	-1,457	+0,975	-0,595	+0,340	-0,178	+6,040 = 0

Henceforth, the individual equations standing in horizontal lines will be denoted always by the simple numerals, 1, 2, 3, 4, 5, ...16, 17, which head them in the first vertical column. From equation 10 on, for which u = 100°, the numerical values of the coefficients of the northern hemisphere recur here and in the following /14
equations (X), (Y), (Z), $(X)_2$, $(Y)_2$, $(Z)_2$..., $(X)_7$, $(Y)_7$, $(Z)_7$ in the southern hemisphere and they have the same sign in both hemispheres, if no ℓ is present as a factor; they have the opposite sign if ℓ is present as a factor. As is easily verified, it is not difficult to discover always such a combination of the primitive equations $(X)_o$, $(Y)_o$, $(Z)_o$,..., $(X)_7$, $(Y)_7$, $(Z)_7$, in which the coefficient of that quantity g or h that is sought is in turn numerically as large as possible and the coefficients of the remaining unknowns g or h are as small as possible or zero. This is done by summing the 17 equations all together or as many as possible with their own signs (indicated in the following columns, N, by +), or with the opposite sign (indicated in the columns by -). In connection with this procedure, there is almost no arbitrariness in the choice of the equations and their sign, if the above mentioned goal is always kept in mind.



Of these equations the pair I serves principally for the determination of $y^{1.0}$, the pair II for the determination of $y^{2.0}$, the pair III, for that of $y^{3.0}$, and IV for that of $y^{4.0}$; furthermore, the equations V are formed for the computation of $y^{5.0}$, VI for the computation of $y^{6.0}$, and finally VII for the computation of $y^{7.0}$, while in I the coefficient of $y^{1.0}$ is greater than that of the other unknowns; in II the coefficient $y^{2.0}$ is greater than those of the other unknowns, etc. Accordingly, we obtain by concentration of the double equations I, II, ... VII the following two groups of equations of which the one contains four unknowns $y^{1.0} y^{2.0} y^{3.0} y^{4.0}$, and the other contains three unknowns $-y^{5.0} y^{6.0} y^{7.0}$

equation (VI).

$$
\begin{aligned}
+32.232\,y^{1.0} + 6.002\,y^{2.0} + 2.696\,y^{3.0} + 0.414\,y^{4.0} - 100.822 &= 0 \\
+0.3327\,y^{1.0} + 17.4549\,y^{2.0} + 3.0664\,y^{3.0} + 0.2267\,y^{4.0} + 1.187 &= 0 \\
+0.4227\,y^{1.0} + 4.342\,y^{2.0} + 7.028\,y^{3.0} + 0.582\,y^{4.0} - 0.351 &= 0 \\
-0.222\,y^{1.0} + 2.236\,y^{2.0} + 1.910\,y^{3.0} + 2.302\,y^{4.0} + 1.397 &= 0
\end{aligned}
$$

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equation (VII).

$$
\begin{aligned}
-27.582\,y^{5.0} + 2.634\,y^{6.0} + 0.867\,y^{7.0} - 4.283 &= 0 \\
+2.7969\,y^{5.0} + 12.110\,y^{6.0} + 1.197\,y^{7.0} + 4.868 &= 0 \\
-0.1809\,y^{5.0} + 1.348\,y^{6.0} + 3.958\,y^{7.0} + 1.058 &= 0
\end{aligned}
$$

The values for $y^{1.0}\,y^{2.0}\,y^{3.0}\,y^{4.0}\,y^{5.0}\,y^{6.0}$ and $y^{7.0}$ which result from this are written into the table (19), which follows further down.

Primitive equation (X)

Eq. no	i.u.	$y^{1.1}$	$y^{2.1}$	$y^{3.1}$	$y^{4.1}$	$y^{5.1}$	$y^{6.1}$	$y^{7.1}$	$+k$	$+k_1$	
1	10	+0.985	+0.940	+0.633	+0.450	+0.260	+0.137	+0.068	+0.207	+0.328	= 0
2	20	+0.940	+0.766	+0.422	+0.161	−0.019	−0.082	−0.084	+0.032	+0.959	= 0
3	30	+0.866	+0.500	+0.043	−0.215	−0.266	−0.205	−0.119	−0.157	+0.519	= 0
4	40	+0.766	+0.174	−0.337	−0.459	−0.321	−0.133	−0.013	−0.265	+0.486	= 0
5	50	+0.643	−0.174	−0.617	−0.462	−0.157	+0.049	+0.090	−0.240	+0.466	= 0
6	60	+0.500	−0.500	−0.725	−0.286	+0.097	+0.160	+0.061	−0.110	+0.397	= 0
7	70	+0.342	−0.766	−0.632	+0.032	+0.256	+0.095	−0.048	−0.161	+0.303	= 0
8	80	+0.174	−0.940	−0.366	+0.316	+0.209	−0.068	−0.084	−0.348	+0.194	= 0
9	90	0.000	−1.000	0.000	+0.428	0.000	−0.151	0.000	−0.419	+0.132	= 0
10	100	−0.174	−0.940	+0.366	+0.316	−0.209	−0.068	+0.084	−0.583	+0.069	= 0
11	110	−0.342	−0.766	+0.632	+0.032	−0.256	+0.095	+0.048	−0.641	−0.062	= 0
12	120	−0.500	−0.500	+0.725	−0.286	−0.097	+0.160	−0.061	−0.511	−0.258	= 0
13	130	−0.643	−0.174	+0.617	−0.462	+0.157	+0.049	−0.090	−0.264	−0.474	= 0
14	140	−0.766	+0.174	+0.337	−0.458	+0.321	−0.133	+0.013	+0.043	−0.654	= 0
15	150	−0.866	+0.500	−0.043	−0.218	+0.266	−0.205	+0.119	+0.373	−0.771	= 0
16	160	−0.940	+0.766	−0.422	+0.161	+0.019	−0.082	+0.084	+0.680	−0.674	= 0
17	170	−0.985	+0.940	−0.633	+0.450	−0.260	+0.137	−0.068	+0.332	−0.474	= 0

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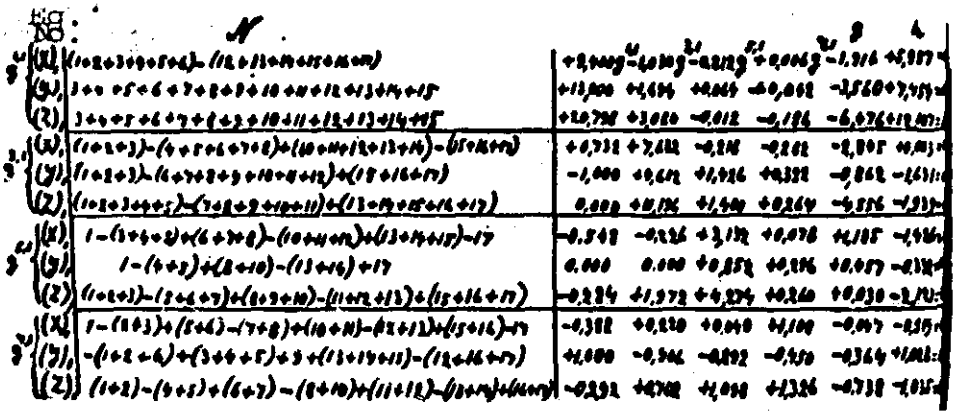
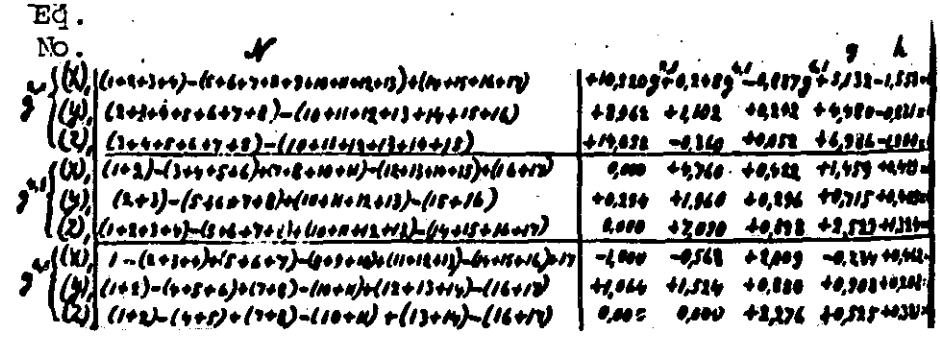
Primitive equation (Y)

Eq. No.	u		c	A	Bc	d,	cB,	A₀	Lℓ, (g)	+ℓ, (h)	
1	10°	+1,000 g	+0,985 g	+0,770 g	+0,513 g	+0,342 g	+0,207 g	+0,121 g	+0,262	+0,332	= 0
2	20	+1,000	+0,940	+0,683	+0,427	+0,239	+0,121	+0,055	+0,219	+0,422	= 0
3	30	+1,000	+0,866	+0,550	+0,278	+0,110	+0,028	-0,003	+0,119	+0,460	= 0
4	40	+1,000	+0,766	+0,337	+0,121	+0,001	-0,029	-0,022	+0,010	+0,473	= 0
5	50	+1,000	+0,643	+0,213	-0,010	-0,057	-0,034	-0,008	-0,023	+0,493	= 0
6	60	+1,000	+0,500	+0,050	-0,089	-0,057	-0,007	+0,010	-0,056	+0,516	= 0
7	70	+1,000	+0,342	-0,083	-0,107	-0,017	+0,020	+0,011	-0,063	+0,541	= 0
8	80	+1,000	+0,174	-0,170	-0,069	+0,028	+0,022	-0,003	-0,073	+0,569	= 0
9	90	+1,000	0.000	-0,200	0,000	+0,048	0,000	-0,012	-0,113	+0,598	= 0
10	100	+1,000	-0,174	-0,170	+0,069	+0,028	-0,022	-0,003	-0,213	+0,637	= 0
11	110	+1,000	-0,342	-0,083	+0,107	-0,017	-0,020	+0,011	-0,331	+0,667	= 0
12	120	+1,000	-0,500	+0,050	+0,089	-0,057	+0,007	+0,010	-0,490	+0,687	= 0
13	130	+1,000	-0,643	+0,213	+0,010	-0,057	+0,034	-0,008	-0,648	+0,670	= 0
14	140	+1,000	-0,766	+0,337	-0,121	+0,001	+0,029	-0,022	-0,797	+0,625	= 0
15	150	+1,000	-0,866	+0,550	-0,278	+0,110	-0,028	-0,003	-0,900	+0,538	= 0
16	160	+1,000	-0,940	+0,683	-0,427	+0,239	-0,121	+0,055	-0,966	+0,461	= 0
17	170	+1,000	-0,985	+0,770	-0,531	+0,342	-0,207	+0,121	-0,937	+0,391	= 0

Primitive Equation (Z).

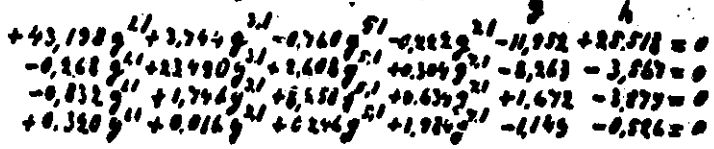
Eq. No.	u	2f	3ef	4fA	5efB	6fA,	7efB,	8fA₀	-m, (g)	-M, (h)	
1	10	+0,347 g	+0,513 g	+0,535 g	+0,463 g	+0,356 g	+0,252 g	+0,168 g	+0,097	-0,097	= 0
2	20	+0,684	+0,964	+0,934	+0,730	+0,490	+0,289	+0,150	+0,299	+0,235	= 0
3	30	+1,000	+1,299	+1,100	+0,696	+0,330	+0,097	-0,011	+0,282	+0,382	= 0
4	40	+1,286	+1,477	+0,995	+0,390	+0,003	-0,130	-0,115	+0,186	+0,595	= 0
5	50	+1,532	+1,477	+0,653	-0,038	-0,262	-0,184	-0,050	-0,011	+0,680	= 0
6	60	+1,732	+1,299	+0,173	-0,387	-0,294	-0,040	+0,073	-0,106	+0,893	= 0
7	70	+1,879	+0,964	-0,312	-0,500	-0,094	+0,133	+0,182	-0,028	+1,024	= 0
8	80	+1,970	+0,513	-0,669	-0,341	+0,168	+0,150	-0,025	-0,005	+1,096	= 0
9	90	+2,000	0,000	-0,800	0,000	+0,286	0.000	-0,094	-0,078	+1,167	= 0
10	100	+1,970	-0,513	-0,669	+0,341	+0,168	-0,150	-0,025	-0,337	+1,307	= 0
11	110	+1,879	-0,964	-0,312	+0,500	-0,094	-0,133	+0,082	-0,759	+1,385	= 0
12	120	+1,732	-1,299	+0,173	+0,387	-0,294	+0,040	+0,073	-1,167	+1,343	= 0
13	130	+1,532	-1,477	+0,653	+0,038	-0,262	+0,184	-0,050	-1,395	+1,131	= 0
14	140	+1,286	-1,477	+0,995	-0,390	+0,003	+0,130	-0,115	-1,527	+0,919	= 0
15	150	+1,000	-1,299	+1,100	-0,696	+0,330	-0,097	-0,011	-1,507	+0,335	= 0
16	160	+0,684	-0,964	+0,934	-0,730	+0,490	-0,289	+0,150	-1,675	+0,127	= 0
17	170	+0,347	-0,513	+0,535	-0,463	+0,356	-0,252	+0,168	-0,488	-0,167	= 0





From this there results through summation of 3 successive rows each $(X)_1$, $(Y)_1$, $(Z)_1$, the two groups of equations (12) and $(12)_\alpha$:

Equation (12)



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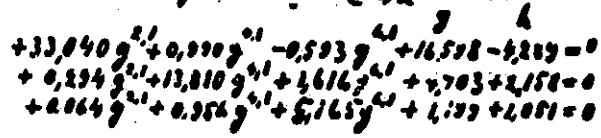
Equation $(12)_\alpha$



With their help, I computed the 14 unknowns $g^{11} g^{21} g^{31} g^{41} g^{22} g^{32} g^{42}$ and $l^{11} l^{21} l^{31} l^{41} l^{22} l^{32} l^{42}$ of the Table (19), which follows further below; in this table, all the coefficients of the Gaussian theory for the year 1885 are collected.

Eq. No.	u	2εf	3fε	4εfγ	5fχ	6εfλ	7f	+c₁	+K₂
1	10	+0,342 g	+0,332 g	+0,272 g	+0,201 g	+0,137 g	+0,077 g	+0,203	+0,032 = 0
2	20	+0,643	+0,564	+0,401	+0,235	+0,113	+0,044	+0,303	+0,055 = 0
3	30	+0,866	+0,655	+0,309	+0,073	−0,008	−0,020	+0,283	+0,113 = 0
4	40	+0,985	+0,492	+0,031	−0,183	−0,202	−0,117	+0,163	+0,127 = 0
5	50	+0,985	+0,183	−0,312	−0,356	−0,186	−0,030	−0,045	+0,136 = 0
6	60	+0,866	−0,216	−0,557	−0,307	−0,008	+0,092	−0,223	+0,136 = 0
7	70	+0,643	−0,610	−0,584	−0,062	+0,164	+0,026	−0,282	+0,118 = 0
8	80	+0,342	−0,896	−0,370	+0,224	+0,166	−0,034	−0,230	+0,064 = 0
9	90	0,000	−1,000	0,000	+0,395	0,000	−0,105	−0,170	−0,018 = 0
10	100	−0,342	−0,896	+0,370	+0,224	−0,166	−0,034	−0,137	−0,086 = 0
11	110	−0,643	−0,610	+0,584	−0,062	−0,164	+0,026	−0,075	−0,137 = 0
12	120	−0,866	−0,216	+0,557	−0,307	+0,008	+0,092	−0,046	−0,130 = 0
13	130	−0,985	+0,183	+0,312	−0,356	+0,186	−0,030	−0,041	−0,125 = 0
14	140	−0,985	+0,492	−0,031	−0,183	+0,202	−0,127	−0,007	−0,129 = 0
15	150	−0,866	+0,655	−0,309	+0,073	+0,048	−0,010	+0,041	−0,077 = 0
16	160	−0,643	+0,564	−0,401	+0,235	−0,119	+0,044	+0,060	−0,117 = 0
17	170	−0,342	+0,332	−0,272	+0,201	−0,137	+0,077	+0,001	+0,005 = 0

Primitive Equation $(y)_2$

Eq. No.	u	2f	2εf	2fλ	2εfγ	2fψ₁	2εfλ₁	−L₂	+l₂
1	10	+0,347 g	+0,342 g	+0,287 g	+0,218 g	+0,154 g	+0,102 g	+0,198	+0,043 = 0
2	20	+0,684	+0,643	+0,506	+0,353	+0,225	+0,132	+0,383	+0,068 = 0
3	30	+1,000	+0,866	+0,607	+0,361	+0,184	+0,078	+0,493	+0,105 = 0
4	40	+1,286	+0,985	+0,572	+0,250	+0,070	−0,002	+0,517	+0,124 = 0
5	50	+1,532	+0,985	+0,414	+0,073	−0,038	−0,042	+0,450	+0,160 = 0
6	60	+1,732	+0,866	+0,185	−0,072	−0,075	−0,022	+0,334	+0,182 = 0
7	70	+1,879	+0,643	−0,049	−0,139	−0,036	+0,018	+0,210	+0,215 = 0

Primitive equation $(y)_2$ continued

Eq. No.	u	2f	2εf	2fλ	2εfγ	2fψ₁	2εfλ₁	−L₂	+l₂
8	80	+1,970 g	+0,342 g	−0,223 g	−0,104 g	+0,030 g	+0,028 g	+0,097	+0,245 = 0
9	90	+2,000	0,000	−0,286	0,000	+0,061	0,000	+0,023	+0,263 = 0
10	100	+1,970	−0,342	−0,223	+0,104	+0,030	−0,028	−0,011	+0,258 = 0
11	110	+1,879	−0,643	−0,049	+0,139	−0,038	−0,018	−0,048	+0,225 = 0
12	120	+1,732	−0,866	+0,185	+0,072	−0,075	+0,022	−0,037	+0,184 = 0
13	130	+1,532	−0,985	+0,414	−0,073	−0,038	+0,042	−0,130	+0,152 = 0
14	140	+1,286	−0,985	+0,571	−0,250	+0,070	+0,002	−0,150	+0,134 = 0
15	150	+1,000	−0,866	+0,607	−0,361	+0,184	−0,078	−0,171	+0,157 = 0
16	160	+0,684	−0,643	+0,506	−0,353	+0,225	−0,132	−0,192	+0,097 = 0
17	170	+0,347	−0,342	+0,287	−0,218	+0,154	−0,102	−0,012	+0,025 = 0

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Primitive Equation $(Z)_2$

Eq. No.	α	g^{22}	g^{32}	g^{42}	g^{52}	g^{62}	g^{72}	$-m_2$	$-M_2$
1	10	+0,030 g^{22}	+0,159 g^{32}	+0,159 g^{42}	+0,139 g^{52}	+0,033 g^{62}	+0,071 g^{72}	−0,329	+0,300 = 0
2	20	+0,357	+0,400	+0,633	+0,363	+0,269	+0,101	+0,225	+0,018 = 0
3	30	+0,750	+0,666	+0,759	+0,501	+0,321	+0,157	+0,457	−0,020 = 0
4	40	+1,200	+1,266	+0,317	+0,482	+0,158	−0,006	+0,719	+0,070 = 0
5	50	+1,760	+1,500	+0,783	+0,101	−0,100	−0,127	+0,786	+0,136 = 0
6	60	+2,250	+1,500	+0,402	−0,107	−0,229	−0,075	+0,646	+0,202 = 0
7	70	+2,649	+1,208	−0,114	−0,372	−0,122	+0,069	+0,623	+0,357 = 0
8	80	+2,909	+0,674	−0,597	−0,306	+0,100	+0,111	+0,811	+0,431 = 0
9	90	+3,000	0,000	−0,775	0,000	+0,212	0,000	+0,026	+0,456 = 0
10	100	+2,909	−0,674	−0,549	+0,306	+0,100	−0,111	−0,064	+0,620 = 0
11	110	+2,649	−1,208	−0,114	+0,372	−0,122	−0,069	−0,136	+0,321 = 0
12	120	+2,250	−1,500	+0,402	+0,107	−0,229	+0,075	−0,135	+0,219 = 0
13	130	+1,760	−1,509	+0,793	−0,101	−0,100	+0,127	−0,158	+0,161 = 0
14	140	+1,240	−1,266	+0,517	−0,482	+0,158	+0,006	−0,200	+0,019 = 0
15	150	+0,750	−0,666	+0,759	−0,501	+0,321	−0,157	−0,214	+0,275 = 0
16	160	+0,351	−0,440	+0,433	−0,363	+0,269	−0,181	−0,023	+0,178 = 0
17	170	+0,090	−0,119	+0,125	−0,113	+0,093	−0,071	−0,298	+0,277 = 0

from this follows

for g^{22} (columns: N, g, h)

$(X)_2$ (1+2+3+4+5+6+7+8)−(10+11+12+13+14+15+16+17) +10,038 g^{22} −4,072 g^{32} −0,569 g^{42} +0,593 +1,223 = 0

$(Y)_2$ 4+5+6+7+8+9+10+11+12+13+14 +18,738 g^{22} +1,810 −0,041 +4,190 +2,145 = 0

$(Z)_2$ 5+6+7+8+9+10+11+12+13 +22,136 +0,154 −0,490 +1,553 +2,743 = 0

g^{42}

$(X)_2$ (1+2+3+4)−(5+6+7+8)+(10+11+12+13)−(14+15+16+17) 0,000 +5,632 −0,260 +1,340 −0,380 = 0

$(Y)_2$ (2+3+4+5)−(7+8+9+10+11)+(13+14+15+16) −0,694 +5,026 +0,837 +0,911 −0,232 = 0

$(Z)_2$ (3+4+5+6)−(7+8+9+10+11)+(12+13+14+15) +0,864 +7,064 +0,344 +1,410 −0,417 = 0

g^{62}

$(X)_2$ (1+2)−(4+5)+(7+8)−(10+11)+(13+14)−(16+17) 0,000 0,000 +1,548 −0,015 −0,016 = 0

$(Y)_2$ (1+2+3)−(5+6+7)+(8+9+10)−(11+12+13)+(15+16+17) −0,244 +0,368 +1,349 +0,132 +0,126 = 0

$(Z)_2$ (2+3+4)−(5+6+7)+(8+9+10)−(11+12+13)+(14+15+16) +0,182 +0,268 +2,810 −0,226 +0,456 = 0

g^{32}

$(X)_2$ (1+2+3+4+5)−(6+7+8+9+10+11+12)+(13+14+15+16+17) +6,830 g^{22} −0,087 g^{42} −0,395 g^{62} +4,126 +0,160 = 0

$(Y)_2$ (4+5+6+7+8)−(10+11+12+13+14) +7,642 +0,028 −0,046 +2,053 −0,026 = 0

$(Z)_2$ (3+4+5+6+7+8)−(10+11+12+13+14+15) +14,046 +0,638 +0,258 +4,086 −0,191 = 0

for

g^{52}

$(X)_2$ (1+2+3)−(4+5+6+7)+(8+9+10)−(11+12+13+14)+(15+16+17) +0,558 g^{32} +2,649 g^{52} −0,483 g^{72} +0,313 +0,012 = 0

$(Y)_2$ (1+2+3+4)−(5+6+7+8)+(10+11+12+13)−(14+15+16+17) 0,007 +2,836 +0,658 +0,616 +0,039 = 0

$(Z)_2$ (2+3+4)−(6+7+8)+(10+11+12)−(14+15+16) −1,630 +4,502 +0,459 +0,257 −0,111 = 0

g^{72}

$(X)_2$ (1+2)−(3+4+5)+(6+7)−(8+9+10)+(11+12)−(13+14+15)+(16+17) +0,334 +0,321 +1,265 +0,096 +0,046 = 0

$(Y)_2$ (1+3)−(4+5+6)+(7+8)−(10+11)+(12+13+14)−(15+16) −0,684 +0,428 +0,604 −0,118 −0,077 = 0

$(Z)_2$ (2+3)−(5+6)+(7+8)−(10+11)+(12+13)−(15+16) +0,358 +0,024 +1,440 +0,035 −0,223 = 0

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No use is made of the primitive equations 1 and 17 of the groups $(Z)_2$, $(Z)_3$, $(Z)_4$, $(Z)_5$, $(Z)_6$ and $(Z)_7$, since the observed values $m_2, M_2, m_3, M_3 \ldots m_7, M_7$ are obviously burdened with significant errors.

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By summation of each three successive equations $(X)_2$, $(Y)_2$ and $(Z)_2$, we obtain for the computation of $g^{11} g^{21} g^{31} k^{11} k^{21} k^{31}$, the equations (13):

$$
\begin{aligned}
&+50{,}991\, g^{11} + 1{,}412\, g^{2,1} - 0{,}575\, g^{3,1} + 3{,}335 + 6{,}117 = 0\\
&+0{,}190\, g^{1,1} + 17{,}762\, g^{2,1} + 0{,}921\, g^{3,1} + 3{,}738 - 6{,}031 = 0\\
&-0{,}102\, g^{1,1} + 1{,}246\, g^{2,1} + 6{,}307\, g^{3,1} - 0{,}119 + 0{,}646 = 0
\end{aligned}
$$

and for the computation of $g^{12} g^{22} g^{32} k^{12} k^{22}$ and k^{32} the equation $(13)_\alpha$:

$$
\begin{aligned}
&+30{,}518\, g^{12} + 0{,}579\, g^{2,2} - 0{,}177\, g^{3,2} + 1{,}265 - 0{,}035 = 0\\
&-1{,}066\, g^{12} + 10{,}993\, g^{2,2} + 0{,}997\, g^{3,2} + 4{,}823 - 0{,}340 = 0\\
&+0{,}012\, g^{1,2} + 4{,}173\, g^{2,2} + 3{,}349\, g^{3,2} + 0{,}071 - 0{,}336 = 0
\end{aligned}
$$

The values of the 12 coefficients $g^{11} g^{21} g^{31} g^{12} g^{22} g^{32} k^{11} k^{21} k^{31} k^{12} k^{22} k^{32}$ are recorded in Table (19).

Primitive Equation $(X)_1$

Eq. No.	u	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	$+k_1$	$+K_1$
1	10°	$+0{,}039\, g^{1,1}$	$+0{,}017\, g^{2,1}$	$+0{,}075\, g^{3,1}$	$+0{,}059\, g^{4,1}$	$+0{,}043\, g^{5,1}$	+0,015	−0,005 = 0
2	20	+0,336	+0,296	+0,229	+0,157	+0,096	−0,020	−0,017 = 0
3	30	+0,699	+0,500	+0,307	+0,145	+0,042	−0,007	−0,007 = 0
4	40	+0,950	+0,557	+0,190	−0,026	−0,057	+0,012	+0,019 = 0
5	50	+1,132	+0,383	−0,101	−0,231	−0,160	+0,067	+0,068 = 0
6	60	+1,125	0,000	−0,406	−0,281	−0,057	+0,033	+0,085 = 0
7	70	+0,906	−0,470	−0,528	−0,109	+0,104	+0,014	+0,071 = 0
8	80	+0,505	−0,853	−0,368	+0,150	+0,135	+0,039	+0,059 = 0
9	90	0,000	−1,000	0,000	+0,273	0,000	+0,026	+0,026 = 0
10	100	−0,505	−0,853	+0,368	+0,150	−0,135	+0,014	0,000 = 0
11	110	−0,906	−0,470	+0,528	−0,109	−0,104	−0,002	+0,002 = 0
12	120	−1,125	0,000	+0,406	−0,281	+0,057	−0,023	−0,028 = 0
13	130	−1,132	+0,383	+0,101	−0,231	+0,160	−0,038	−0,050 = 0
14	140	−0,950	+0,557	−0,190	−0,026	+0,097	−0,059	−0,060 = 0
15	150	−0,699	+0,500	−0,307	+0,145	−0,042	−0,073	−0,062 = 0
16	160	−0,330	+0,296	−0,229	+0,157	−0,096	−0,033	−0,048 = 0
17	170	−0,039	+0,067	−0,075	+0,059	−0,043	−0,066	+0,006 = 0

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Primitive Equation (Y)₃

Eq. No.	α	$3f^1$	$3ef^2$	$3f\xi$	$3ef\cdot F$	$3f^2\xi_1$	$-l_3$	$+l_3$
1	10°	+0,030 $g^{1,3}$	+0,0199 $g^{4,3}$	+0,078 $g^{0,3}$	+0,0625 $g^{4,3}$	+0,046 $g^{2,3}$	+0,011	−0,009 = 0
2	20	+0,351	+0,330	+0,271	+0,201	+0,138	−0,029	−0,012 = 0
3	30	+0,750	+0,649	+0,479	+0,316	+0,178	−0,054	+0,010 = 0
4	40	+1,239	+0,950	+0,590	+0,239	+0,112	−0,068	+0,025 = 0
5	50	+1,760	+1,132	+0,532	+0,159	+0,002	−0,036	+0,041 = 0
6	60	+2,250	+1,128	+0,313	−0,026	−0,072	+0,006	+0,055 = 0
7	70	+2,649	+0,906	+0,016	−0,161	−0,051	+0,051	+0,091 = 0
8	80	+2,909	+0,505	−0,236	−0,123	+0,023	+0,085	+0,142 = 0
9	90	+3,000	0,000	−0,333	0,000	+0,063	+0,117	+0,169 = 0
10	100	+2,909	−0,505	−0,236	+0,123	+0,023	+0,125	+0,169 = 0
11	110	+2,649	−0,906	+0,616	+0,141	−0,051	+0,131	+0,158 = 0
12	120	+2,250	−1,128	+0,313	+0,026	−0,072	+0,135	+0,152 = 0
13	130	+1,760	−1,132	+0,532	−0,159	+0,002	+0,151	+0,139 = 0
14	140	+1,239	−0,950	+0,590	−0,239	+0,117	+0,165	+0,133 = 0
15	150	+0,750	−0,649	+0,479	−0,310	+0,178	+0,151	+0,094 = 0
16	160	+0,351	−0,380	+0,271	−0,201	+0,138	+0,103	+0,065 = 0
17	170	+0,030	−0,089	+0,078	−0,063	+0,046	+0,048	+0,011 = 0

Primitive Equation (Z)₃.

Eq. No.	α	$4f^1$	$5ef^3$	$6f^3\xi$	$7ef^2F$	$8f^2\xi_1$	$-m_3$	$-M_3$
1	10°	+0,021 $g^{1,3}$	+0,016 $g^{0,3}$	+0,029 $g^{0,3}$	+0,025 $g^{4,3}$	+0,028 $g^{2,3}$	+0,161	+0,014 = 0
2	20	+0,160	+0,188	+0,185	+0,161	+0,126	+0,098	+0,000 = 0
3	30	+0,500	+0,541	+0,479	+0,362	+0,237	−0,065	+0,105 = 0
4	40	+1,062	+1,017	+0,758	+0,447	+0,201	−0,149	−0,078 = 0
5	50	+1,792	+1,444	+0,814	+0,284	+0,004	−0,072	−0,084 = 0
6	60	+2,598	+1,624	+0,541	−0,052	−0,166	−0,010	+0,071 = 0
7	70	+3,320	+1,419	+0,029	−0,309	−0,128	+0,049	+0,164 = 0
8	80	+3,820	+0,829	−0,464	−0,282	+0,061	+0,113	+0,196 = 0
9	90	+4,000	0,000	−0,667	0,000	+0,161	+0,150	+0,225 = 0
10	100	+3,820	−0,829	−0,464	+0,282	+0,061	+0,092	+0,232 = 0
11	110	+3,320	−1,419	+0,029	+0,369	−0,128	+0,123	+0,235 = 0
12	120	+2,598	−1,624	+0,541	+0,052	−0,166	+0,173	+0,222 = 0
13	130	+1,792	−1,444	+0,814	−0,284	+0,004	+0,161	+0,197 = 0
14	140	+1,062	−1,017	+0,758	−0,447	+0,201	+0,1[illegible]	+0,217 = 0
15	150	+0,500	−0,541	+0,479	−0,362	+0,237	+0,202	+0,037 = 0
16	160	+0,160	−0,188	+0,185	−0,161	+0,126	+0,108	+0,034 = 0
17	170	+0,021	−0,016	+0,029	−0,025	+0,028	+0,140	−0,144 = 0

From the preceding primitive equations $(X)_3$, $(Y)_3$ and $(Z)_3$, I derive the following:

tor

		N					
f (1,1)	$(X)_3$	(1+2+3+4+5+6+7+8)−(10+11+12+13+14+15+16+17)	+3,5669	−0,1489	+0,009	+4,357	+0,444 = 0
	$(Y)_3$	−(2+3)+(4+5+6+7+8+9+10+11+12+13+14)−(15+16)	+22,412	+0,597	−0,531	+0,689	+1,137 = 0
	$(Z)_3$	(2+3)+4+(5+6+7+8+9+10+11+12+13)−14+(15+16)	+26,161	+0,485	+0,034	+1,034	+1,625 = 0
g (4,1)	$(X)_3$	(1+2+3)+4−(6+7+8)+(11+12+13)−(14+15+16+17)	−1,036	+4,206	−0,196	+0,134	−0,089 = 0
	$(Y)_3$	(1+2+3)+4+5+6)−(7+8+9+10+11)+(12+13+14+15+16+17)	−6,236	+5,299	+0,811	+0,076	−0,065 = 0
	$(Z)_3$	(2+3)+4+5+6)−(8+9+10)+(12+13+14+15+16)	+0,296	+7,149	+0,816	+0,328	+0,198 = 0

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for g^{3}:

$(X)_3$ (2+3)−(5+6)+(7+8)−(10+11)+(12+13)−(15+16) +0,266 $g^{3,3}$ +0,274 $g^{6,3}$ +1,189 $g^{9,3}$ −2,011 −4,077 = 0

$(Y)_3$ (1+2+3+4)−(5+6+7)+(8+9+10)−(11+12+13)+(14+15+16+17) +4,360 +0,301 +4,309 +0,236 +0,101 = 0

$(Z)_3$ (2+3+4)−(5+6+7)+(8+9+10)−(11+12+13)+(14+15+16) −0,348 −1,519 +1,998 +0,362 +0,193 = 0

for g^{4}:

$(X)_4$ (1+2+3+4+5)−(7+8+9+10+11)+(13+14+15+16+17) +7,292 $g^{4,3}$ −0,407 $g^{6,4}$ −4,313 −0,349 = 0

$(Y)_4$ −(1+2)+(3+4+5+6+7+8)−(10+11+12+13+14+15)+(16+17) +7,636 +0,418 −0,703 −0,904 = 0

$(Z)_4$ −2+(4+5+6+7+8)−(10+11+12+13+14)+16 +12,230 −0,166 −0,765 −0,838 = 0

$(X)_5$ (1+2+3+4)−(5+6+7)+(8+9+10)−(11+12+13)+(14+15+16+17) +0,368 +2,088 −0,183 −0,237 = 0

$(Y)_5$ (1+2+3+4)−(6+7)+(11+12)−(14+15+16+17) −0,026 +2,036 −4,404 −0,105 = 0

$(Z)_5$ (3+4+5)−(6+7)+(8+10)−(13+14+15) −0,082 +2,108 −0,549 −0,236 = 0

The final equation (14) for $g^{3,3}, g^{6,3}, g^{9,3}, h^{3,3}, h^{6,3}, h^{9,3}$ and $(14)_\alpha$ for $g^{4,3}, g^{6,4}$ and $h^{4,3}, h^{6,4}$, are accordingly:

Equation (14)

$$+58,240\,g^{3,3} + 1,434\,g^{6,3} - 0,493\,g^{9,3} + 2,120 + 3,106 = 0$$
$$-1,676\,g^{3,3} + 16,654\,g^{6,3} + 1,129\,g^{9,3} + 0,538 + 0,066 = 0$$
$$+0,278\,g^{3,3} - 0,916\,g^{6,3} + 4,495\,g^{9,3} + 0,567 + 0,317 = 0$$

Equation $(14)_\alpha$

$$+29,278\,g^{4,3} + 0,135\,g^{6,4} - 1,781 - 1,549 = 0$$
$$+0,290\,g^{4,3} + 7,469\,g^{6,4} - 1,136 - 0,579 = 0$$

The values of $g^{3,3}, g^{6,3}, g^{9,3}, g^{4,3}, g^{6,4}, h^{3,3}, h^{6,3}, h^{9,3}, h^{4,3}$ and $h^{6,4}$ computed according to (14) and $(14)_\alpha$, are, like the values of the other coefficients of the theory, also cted in Table (19).

Eq. No.	u	Primitive Equa. (X)						Primitive Equation (Y)					
						$+K_4$						$-L_4$	$+l_4$
1	10	+0,0219	+0,0219	+0,0189	+0,0159	−0,006	−0,016 = 0	+0,0219	+0,0219	+0,0189	+0,0189	−0,001	−0,013 = 0
2	20	+0,150	+0,137	+0,110	+0,081	+0,002	0,000 = 0	+0,160	+0,150	+0,127	+0,098	−0,016	−0,008 = 0
3	30	+0,493	+0,394	+0,238	+0,132	−0,013	−0,001 = 0	+0,500	+0,433	+0,330	+0,225	−0,016	−0,030 = 0
4	40	+0,814	+0,514	+0,236	+0,054	−0,005	−0,010 = 0	+1,062	+0,814	+0,527	+0,290	−0,030	−0,062 = 0
5	50	+1,156	+0,479	+0,038	−0,130	+0,013	−0,010 = 0	+1,798	+1,156	+0,580	+0,211	−0,039	−0,081 = 0
6	60	+1,299	+0,162	−0,290	−0,240	+0,033	+0,007 = 0	+2,598	+1,299	+0,413	+0,025	−0,016	−0,089 = 0
7	70	+1,135	−0,344	−0,472	−0,132	+0,032	+0,004 = 0	+3,320	+1,135	+0,067	−0,129	+0,015	−0,073 = 0
8	80	+0,663	−0,811	−0,362	+0,107	+0,016	+0,008 = 0	+3,820	+0,663	−0,232	−0,133	+0,047	−0,058 = 0
9	90	0,000	−1,000	0,000	+0,231	+0,024	+0,012 = 0	+4,000	0,000	−0,366	0,001	+0,036	−0,052 = 0
10	100	−0,663	−0,811	+0,362	+0,107	+0,014	+0,013 = 0	+3,820	−0,663	−0,232	+0,133	+0,040	−0,039 = 0
11	110	−1,135	−0,344	+0,472	−0,132	−0,014	−0,003 = 0	+3,320	−1,135	+0,067	+0,129	+0,029	−0,019 = 0
12	120	−1,299	+0,162	+0,290	−0,240	−0,022	+0,005 = 0	+2,598	−1,299	+0,413	−0,025	+0,019	−0,016 = 0
13	130	−1,156	+0,479	−0,033	−0,130	−0,022	+0,020 = 0	+1,798	−1,156	+0,580	−0,211	+0,030	−0,020 = 0
14	140	−0,814	+0,514	−0,236	+0,054	−0,019	+0,017 = 0	+1,062	−0,814	+0,527	−0,290	+0,045	−0,019 = 0
15	150	−0,433	+0,394	−0,231	+0,132	−0,024	+0,010 = 0	+0,500	−0,433	+0,330	−0,225	+0,037	−0,014 = 0
16	160	−0,150	+0,137	−0,110	+0,081	−0,025	+0,005 = 0	+0,160	−0,150	+0,127	−0,098	+0,025	+0,006 = 0
17	170	−0,021	+0,020	−0,018	+0,015	+0,013	−0,021 = 0	+0,021	−0,021	+0,018	−0,015	−0,005	+0,026 = 0

Primitive Equation $(Z)_4$

Eq. No.	q						
1	10	+0,0053	+0,0053	+0,0063	+0,0063	+0,078	−0,267 = 0
2	20	+0,068	+0,077	+0,076	+0,067	−0,017	−0,063 = 0
3	30	+0,313	+0,325	+0,288	+0,225	+0,210	−0,004 = 0
4	40	+0,834	+0,785	+0,593	+0,372	−0,013	−0,061 = 0
5	50	+1,784	+1,327	+0,777	+0,383	−0,036	−0,149 = 0
6	60	+2,813	+1,687	+0,656	+0,043	−0,034	−0,073 = 0
7	70	+3,859	+1,600	+0,142	−0,243	+0,073	−0,036 = 0
8	80	+4,703	+0,980	−0,480	−0,262	+0,115	−0,038 = 0
9	90	+5,000	0,000	−0,636	0,000	+0,073	+0,003 = 0
10	100	+4,703	−0,980	−0,480	+0,262	+0,034	+0,001 = 0
11	110	+3,859	−1,600	+0,142	+0,243	−0,013	−0,004 = 0
12	120	+2,813	−1,687	+0,656	−0,043	−0,029	−0,035 = 0
13	130	+1,784	−1,327	+0,777	−0,383	+0,013	−0,047 = 0
14	140	+0,834	−0,785	+0,593	−0,372	+0,001	−0,018 = 0
15	150	+0,313	−0,325	+0,288	−0,225	−0,003	−0,003 = 0
16	160	+0,068	−0,077	+0,076	−0,067	−0,006	+0,006 = 0
17	170	+0,005	−0,005	+0,006	−0,005	−0,000	+0,000 = 0

I form the following equations from $(X)_4$, $(Y)_4$ and $(Z)_4$:

for				
$g^{3,4}$	$(X)_4$	$(2+3+4+5+6)+8-10-(11+12+13+14)$	+2,230	−0,669 +0,166 −0,077 = 0
	$(Y)_4$	$-(2+3)+(5+6+7+8+9+10+11+12+13)-(15+16)$	+25,752	+0,918 +0,257 −0,399 = 0
	$(Z)_4$	$-2+3+4)+(5+6+7+8+9+10+11+12+13)-(14+15+16)$	+23,804	−0,268 +0,030 −0,136 = 0
$g^{4,4}$	$(X)_4$	$(2+3+4+5)-(6+7)+(11+12)-(13+14+15+16)$	+0,238	+2,724 −0,014 −0,003 = 0
	$(Y)_4$	$(1+2+3+4+5+6)-(8+9+10)+(12+13+14+15+16+17)$	+0,638	+6,818 −0,170 −0,167 = 0
	$(Z)_4$	$(2+3+4+5+6+7)-(8+9+10)+(11+12+13+14+15+16)$	−0,634	+5,188 −0,065 −0,152 = 0
$g^{2,4}$	$(X)_4$	$(2+3+4+5)-(7+8+9+10+11)+(13+14+15+16)$	+6,258	+0,093 −0,185 −0,002 = 0
	$(Y)_4$	$-(2+3)+(4+5+6+7+8)-(10+11+12+13+14)+(15+16)$	+2,368	−0,118 −0,068 −0,220 = 0
	$(Z)_4$	$-3+(4+5+6+7+8)-(10+11+12+13+14)+15$	+12,108	+0,016 −0,114 −0,139 = 0
$g^{3,4}$	$(X)_4$	$(1+2+3+4)-(6+7)+(8+9+10)-(11+12)+(14+15+16+17)$	−0,228	+1,753 −0,032 +0,005 = 0
	$(Y)_4$	$(1+2+3+4+5)-(6+7)+(11+12)-(13+14+15+16+17)$	+0,280	+1,186 −0,187 −0,059 = 0
	$(Z)_4$	$(1+3+4+5)-(7+8)+(10+11)-(13+14+15+16)$	−0,132	+2,934 +0,022 −0,112 = 0

and accordingly the final equations (15) and $(15)_\alpha$ for computing $g^{3,4}$, $g^{4,4}$, $A^{3,4}$, $A^{4,4}$ and $g^{2,4}$, $g^{3,4}$, $A^{2,4}$, $A^{3,4}$:

Equation (15)

+43,584	$g^{3,4}$ +0,0349	$g^{4,4}$ +0,401 − 0,660 = 0
+0,1225	$g^{3,4}$ +13,7309	$g^{4,4}$ −0,253 − 0,442 = 0

Equation $(15)_4$

+27,3349	$g^{3,4}$ −0,009	$g^{4,4}$ −0,367 − 0,361 = 0
−0,030	$g^{3,4}$ +6,6239	$g^{4,4}$ −0,149 − 0,157 = 0

The values of the unknowns thus obtained are recorded in Table (19)

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Primitive Equation $(X)_s$ · Primitive Equation $(Y)_s$

Eq. No.	u	$\frac{\partial f^0}{\partial t}$	$\frac{\partial f^1}{\partial x}$	$\frac{\partial f^2}{\partial z_0}$	$+k_s$	$+\bar{k}_s$	f^0	$\frac{\partial f^0}{\partial y}$	$\frac{\partial f^1}{\partial z}$	$-\bar{k}_s + l_s$
1	10	$+0.0049\,g^{1,5}$	$+0.0049\,g^{4,5}$	$+0.0049\,g^{3,5}$	-0.007	$-0.005 = 0$	$+0.0057\,g^{2,5}$	$+0.0049\,g^{4,5}$	$+0.0049\,g^{3,5}$	$-0.005+0.011 = 0$
2	20	+0.064	+0.059	+0.049	-0.002	$-0.001 = 0$	+0.068	+0.064	+0.055	$0.000+0.002 = 0$
3	30	+0.231	+0.217	+0.151	-0.005	$+0.005 = 0$	+0.243	+0.231	+0.210	$+0.001+0.006 = 0$
4	40	+0.634	+0.538	+0.225	$+0.007$	$+0.011 = 0$	+0.815	+0.634	+0.435	$+0.012+0.026 = 0$
5	50	+1.726	+0.503	+0.112	+0.024	$+0.007 = 0$	+4.722	+1.186	+0.579	$+0.023+0.030 = 0$
6	60	+1.906	+0.282	-0.179	+0.032	$+0.001 = 0$	+3.213	+1.607	+0.487	$+0.033+0.028 = 0$
7	70	+1.334	-0.231	-0.418	+0.013	$+0.008 = 0$	+3.099	+1.334	+0.156	$+0.042+0.023 = 0$
8	80	+0.317	-0.771	-0.355	-0.017	$-0.001 = 0$	+4.703	+0.317	-0.220	$+0.045+0.024 = 0$
9	90	0.000	-1.007	0.000	-0.020	$-0.013 = 0$	+5.000	0.000	-0.384	$+0.034+0.022 = 0$
10	100	-0.317	-0.771	+0.355	-0.020	$-0.011 = 0$	+4.703	-0.317	-0.220	$+0.023+0.004 = 0$
11	110	-1.334	-0.231	+0.418	-0.018	$-0.007 = 0$	+3.099	-1.334	+0.156	$+0.010-0.008 = 0$
12	120	-1.906	+0.282	+0.179	-0.006	$-0.003 = 0$	+2.813	-1.607	+0.487	$-0.003-0.022 = 0$
13	130	-1.726	+0.503	-0.112	0.000	$-0.007 = 0$	+1.722	-1.186	+0.579	$-0.008-0.026 = 0$
14	140	-0.634	+0.538	-0.225	-0.003	$-0.008 = 0$	+0.634	-0.634	+0.435	$-0.007-0.028 = 0$
15	150	-0.231	+0.217	-0.151	-0.007	$-0.002 = 0$	+0.313	-0.231	+0.210	$-0.021-0.003 = 0$
16	160	-0.064	+0.059	-0.049	-0.013	$-0.002 = 0$	+0.078	-0.064	+0.055	$-0.037-0.010 = 0$
17	170	-0.004	+0.004	-0.004	$+0.002$	$+0.002 = 0$	+0.005	-0.004	+0.004	$+0.006-0.002 = 0$

Primitive Equation $(Z)_s$

Eq. No.	u	$\frac{\partial f^0}{\partial t}$	$\frac{\partial f^0}{\partial x}$	$\frac{\partial f^0}{\partial y}$	$\frac{\partial f^1}{\partial z}$	$-m_s - \bar{m}_s$
1	10	$+0.021\,g^{2,5}$	$+0.001\,g^{4,5}$	$+0.001\,g^{3,5}$	-0.174	$+0.151 = 0$
2	20	+0.028	+0.031	+0.030	-0.016	$-0.054 = 0$
3	30	+0.188	+0.189	+0.168	+0.015	$-0.066 = 0$
4	40	+0.659	+0.588	+0.448	-0.015	$+0.074 = 0$
5	50	+1.583	+1.187	+0.709	-0.018	$+0.045 = 0$
6	60	+2.923	+1.705	+0.674	-0.015	$+0.059 = 0$
7	70	+3.397	+1.754	+0.235	+0.034	$+0.051 = 0$
8	80	+3.358	+1.126	-0.347	+0.033	$+0.065 = 0$
9	90	+6.000	0.000	-0.615	+0.034	$+0.052 = 0$
10	100	+3.358	-1.126	-0.347	+0.027	$+0.034 = 0$
11	110	+3.397	-1.754	+0.235	+0.022	$-0.007 = 0$
12	120	+2.923	-1.705	+0.674	+0.030	$-0.028 = 0$
13	130	+1.583	-1.187	+0.709	+0.013	$-0.054 = 0$
14	140	+0.659	-0.588	+0.448	+0.005	$-0.038 = 0$
15	150	+0.188	-0.189	+0.168	-0.007	$+0.004 = 0$
16	160	+0.028	-0.031	+0.030	-0.034	$-0.026 = 0$
17	170	+0.001	-0.001	+0.001	$+0.066$	$-0.077 = 0$

Hence:

for

11	$(X)_s$	$(2+3+4+5+6) + 8 - 10 - (12+13+14+15+16)$	$+0.6369\,g^{2,5}$	$+0.014\,g^{3,5}$	$+0.017+0.013 = 0$
	$(Y)_s$	$(1+2+3) - 4 + (6+7+8+9+10+11+12) - 14 + (15+16+17)$	$+26.8949\,g^{2,5}$	$+0.130$	$+0.123+0.022 = 0$
	$(Z)_s$	$3 - 4 + (6+7+8+9+10+11+12) - 14 + 15$	$+30.814$	-0.051	$+0.203+0.151 = 0$
12	$(X)_s$	$(1+2+3+4+5) - (7+8) + (10+11) - (13+14+15+16+17)$	-0.104	$+0.636$	$+0.013+0.003 = 0$
	$(Y)_s$	$(1+2+3+4+5+6) + 7 - (8+9+10) + 11 + (13+14+15+16+17)$	-0.484	$+3.702$	$-0.026-0.020 = 0$
	$(Z)_s$	$2 + (5+6+7) - (8+9+10) + (11+12+13) + 16$	$+0.746$	$+4.605$	$-0.10-0.175 = 0$

for

$$g^{4,5}\begin{cases}(X)_5 & (1+2+3+4+5+6)-(7+8+9+10+11)+(12+13+14+15+16+17) & +6,014\,g^{4,5} & +0,075 & +0,024=0\\ (Y)_5 & (1+2+3+4+5+6+7+8)-(10+11+12+13+14+15+16+17) & +11,314 & +0,188 & +0,226=0\\ (Z)_5 & (2+3+4+5+6+7+8)-(10+11+12+13+14+15+16) & +13,160 & -0,166 & +0,317=0\end{cases}$$

Hence by summation:

Equation (16)

$$+46,344\,g^{0,5}+0,093\,g^{2,5}+0,623\,g+0,286\,h=0$$
$$-0,002\,g^{0,5}+10,953\,g^{2,5}-0,183\,g-0,226\,h=0$$

Equation (16a)

$$30,488\,g^{4,5}+0,097\,g+0,567\,h=0$$

According to which I have derived the values of $g^{0,5}\,g^{4,5}\,g^{2,5}\,h^{0,5}\,h^{4,5}\,h^{2,5}$ recorded in Table (19).

Primitive Equation $(X)_6$

Eq. No.	u	$6\epsilon f^{5}$	$7 f^{5}$	$+x_6$	K_6
1	10	+0,001 $g^{4,6}$	+0,001 $g^{2,6}$	0,000	+0,008 = 0
2	20	+0,026	+0,024	+0,004	+0,002 = 0
3	30	+0,162	+0,133	+0,010	−0,004 = 0
4	40	+0,504	+0,341	+0,005	−0,003 = 0
5	50	+1,017	+0,499	+0,001	−0,021 = 0
6	60	+1,461	+0,365	+0,007	−0,020 = 0
7	70	+1,504	−0,133	+0,005	+0,009 = 0
8	80	+0,965	−0,731	−0,010	+0,023 = 0
9	90	0,000	−1,000	−0,092	+0,015 = 0
10	100	−0,965	−0,731	−0,004	+0,017 = 0
11	110	−1,504	−0,133	−0,006	+0,012 = 0
12	120	−1,461	+0,365	+0,004	+0,008 = 0
13	130	−1,017	+0,499	+0,003	+0,005 = 0
14	140	−0,504	+0,341	+0,006	+0,003 = 0
15	150	−0,162	+0,133	+0,011	−0,006 = 0
16	160	−0,026	+0,024	+0,016	−0,013 = 0
17	170	−0,001	+0,001	−0,001	−0,008 = 0

Primitive Equation $(Y)_6$

Eq. No.	$6 f^{5}$	$6\epsilon f^{5}$	$-L_6$	$+l_6$
1	+0,001 $g^{4,6}$	+0,001 $g^{2,6}$	+0,002	+0,010 = 0
2	+0,028	+0,026	+0,008	0,000 = 0
3	+0,188	+0,162	0,000	−0,011 = 0
4	+0,659	+0,504	−0,004	−0,003 = 0
5	+1,583	+1,017	−0,005	−0,002 = 0
6	+2,923	+1,461	−0,010	−0,002 = 0
7	+4,397	+1,504	−0,012	−0,019 = 0
8	+5,558	+0,965	−0,002	−0,017 = 0
9	+6,000	0,000	+0,005	−0,010 = 0
10	+5,558	−0,965	+0,005	−0,002 = 0
11	+4,397	−1,504	+0,001	0,000 = 0
12	+2,923	−1,461	−0,007	0,000 = 0
13	+1,583	−1,017	−0,005	0,000 = 0
14	+0,659	−0,504	+0,001	+0,002 = 0
15	+0,188	−0,162	−0,013	−0,005 = 0
16	+0,028	−0,026	+0,005	−0,006 = 0
17	+0,001	−0,001	−0,002	+0,003 = 0

Primitive Equation $(Z)_6$

Eq. No.	u	$7 f^{6}$	$8\epsilon f^{6}$	$-m_6$	$-M_6$
1	10°	0,000 $g^{4,6}$	0,000 $g^{2,6}$	+0,123	+0,029 = 0
2	20	+0,011	+0,012	−0,025	+0,017 = 0
3	30	+0,109	+0,108	−0,091	−0,006 = 0
4	40	+0,494	+0,432	+0,005	−0,004 = 0
5	50	+1,414	+1,035	−0,035	+0,007 = 0
6	60	+2,953	+1,687	−0,020	+0,028 = 0
7	70	+4,820	+1,884	+0,010	−0,007 = 0
8	80	+6,316	+1,267	+0,003	0,000 = 0
9	90	+7,000	0,000	0,000	−0,007 = 0
10	100°	+6,316	−1,267 $g^{2,6}$	−0,013	+0,007 = 0
11	110	+4,820	−1,884	+0,002	+0,001 = 0
12	120	+2,953	−1,687	+0,031	+0,003 = 0
13	130	+1,414	−1,035	−0,004	+0,008 = 0
14	140	+0,494	−0,432	−0,001	−0,007 = 0
15	150	+0,109	−0,108	0,000	−0,023 = 0
16	160	+0,011	−0,012	−0,071	−0,024 = 0
17	170	0,000	0,000	−0,037	+0,041 = 0

From these I found:

for

$$(1)_{44}\quad (1+2+3+4+5+6+7+8)-(10+11+12+13+14+15+16+17)\quad +12,269\,g^{44}-0,009-0,024=0$$
$$(3)_{4}\quad 1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17\quad +36,674\,g^{44}-0,033-0,067=0$$
$$(2)_{4}\quad 2+3+4+5+6+7+8+9+10+11+12+13+14+15+16\quad +39,742\,g^{44}-0,307-0,007=0$$
$$(1)_{46}\quad (1+2+3+4+5+6)-(7+8+9+10+11+12+13+14+15+16+17)\quad +8,454\,g^{46}+0,013-0,125=0$$
$$(3)_{6}\quad (1+2+3+4+5+6+7+8)-(10+11+12+13+14+15+16+17)\quad +11,280\,g^{46}-0,001-0,041=0$$
$$(2)_{6}\quad (2+3+4+5+6+7+8)-(10+11+12+13+14+15+16)\quad +12,152\,g^{46}-0,017+0,010=0$$

Hence by summation:

Equation (17)

$$12,328\,g^{44}-0,249-0,091=0$$

Equation $(17)_{\alpha}$

$$23,592\,g^{46}-0,022-0,036=0$$

thus $g^{44}, g^{46}, h^{44}, h^{46}$ in Table (19) are calculated.

Eq. No.	μ	Primitive Equation (X), γf^{27}	$+K_\gamma$	$+k_\gamma$	Prim. Equation, γf^{26}	$-L_\gamma$	$+l_\gamma$	Prim. Equation (Z), βf^{27}	$-m_\gamma$	$-n_\gamma$
1	10	$0,000\,g^{27}$	$+0,003$	$+0,059=0$	$0,000\,g^{27}$	$+0,002$	$-0,002=0$	$0,000\,g^{27}$	$+0,009$	$-0,023=0$
2	18	$+2,011$	$0,006$	$+0,002=0$	$+2,011$	$-0,001$	$+0,002=0$	$+0,004$	$+0,041$	$+0,106=0$
3	36	$+0,037$	$+0,003$	$-0,003=0$	$+0,109$	$-0,002$	$+0,005=0$	$+0,062$	$-0,016$	$+0,034=0$
4	48	$+0,374$	$+0,013$	$-0,001=0$	$+0,434$	$+0,007$	$-0,017=0$	$+0,363$	$+0,013$	$-0,028=0$
5	50	$+0,305$	$+0,007$	$-0,004=0$	$+1,414$	$+0,005$	$-0,003=0$	$+1,236$	$-0,007$	$+0,011=0$
6	68	$+1,477$	$-0,001$	$+0,004=0$	$+2,353$	$-0,003$	$-0,011=0$	$+2,343$	$+0,013$	$+0,007=0$
7	70	$+1,644$	$-0,003$	$-0,006=0$	$+4,828$	$+0,002$	$-0,016=0$	$+5,177$	$+0,003$	$+0,012=0$
8	80	$+1,107$	$+0,001$	$+0,005=0$	$+6,334$	$+0,007$	$-0,023=0$	$+7,147$	$+0,007$	$+0,018=0$
9	90	$0,000$	$0,000$	$+0,002=0$	$+7,000$	$+0,013$	$-0,017=0$	$+8,000$	$-0,005$	$-0,010=0$
10	100	$-1,109$	$0,000$	$+0,004=0$	$+6,346$	$+0,012$	$-0,001=0$	$+7,187$	$-0,001$	$-0,003=0$
11	118	$-1,648$	$+0,004$	$+0,004=0$	$+4,828$	$+0,011$	$-0,003=0$	$+5,177$	$+0,006$	$+0,004=0$
12	120	$-1,477$	$-0,005$	$-0,003=0$	$+2,353$	$+0,007$	$+0,002=0$	$+2,343$	$-0,017$	$-0,015=0$
13	138	$-0,369$	$0,000$	$-0,003=0$	$+1,414$	$+0,005$	$+0,006=0$	$+1,236$	$-0,017$	$0,000=0$
14	140	$-0,378$	$+0,001$	$-0,004=0$	$+0,434$	$+0,005$	$+0,007=0$	$+0,363$	$+0,013$	$+0,003=0$
15	150	$-0,035$	$+0,002$	$-0,005=0$	$+0,109$	$+0,002$	$+0,006=0$	$+0,062$	$-0,016$	$-0,033=0$
16	160	$-0,011$	$+0,017$	$+0,001=0$	$+0,011$	$+0,004$	$+0,008=0$	$+0,004$	$+0,073$	$-0,063=0$
17	170	$0,000$	$-0,012$	$-0,005=0$	$0,000$	$-0,004$	$-0,002=0$	$0,000$	$-0,053$	$-0,177=0$

Hence:

$$(1)_{27}\quad (1+2+3+4+5+6+7+8)-(10+11+12+13+14+15+16+17)\quad +11,254\,g^{27}+0,000+0,001=0$$
$$(3)_{7}\quad 1+2+3+4+5+6+7+8+9+10+11+12+13+14+15+16+17\quad +39,374\quad +0,089-0,030=0$$
$$(2)_{7}\quad 2+3+4+5+6+7+8+9+10+11+12+13+14+15+16\quad +41,908\quad +0,085+0,106=0$$

Thus the sum: Equation (18)

$$22,534\,g^{27}+0,174+0,057=0$$

according to which g^{27} and h^{27} of the immediately following table (19) are computed. The results of our computations are therefore the following 63 coefficients of the Gaussian theory of the Earth's magnetism:

TABLE (19)

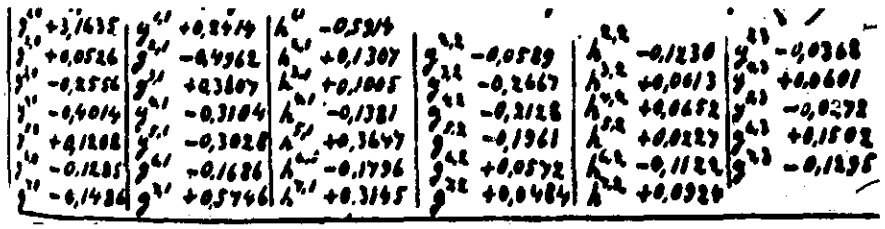
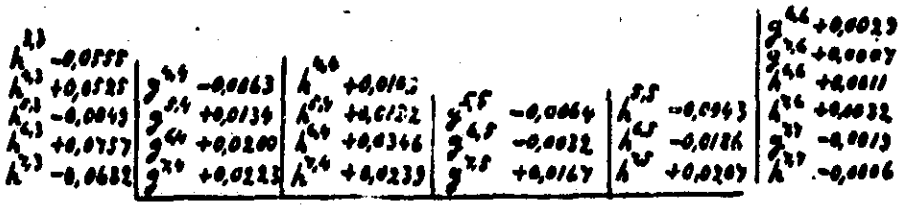


Table (19) continued



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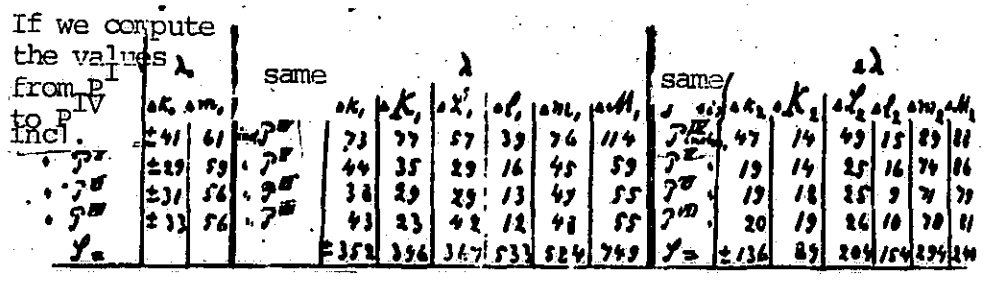
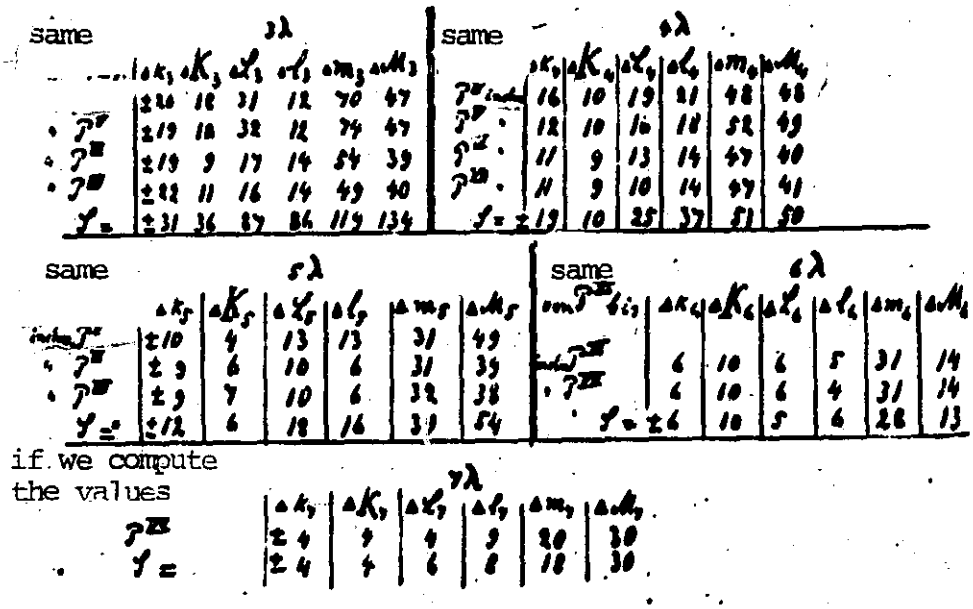
Now I turn to a check of the above coefficients g, h of the theory against the observations. First of all, with their help, I have computed the coefficients k, l, m, K, L, M of cosnλ and sinnλ of the series which represents X, Y and Z, and have compared them with the observed k, l, m, K, L, M of the above Tables (5), (6) and (7). The result of this work is compiled in the following table. This table contains in Gaussian units of the third decimal place the average deviation (i.e., the average of the differences between calculation and observation, taken without regard for their signs ±) of the values of the quantities k, l, m, K, L, M calculated according to the theory from the values concluded from the observations in our above Tables (5), (6) and (7):





$\mathcal{Y}$ are the averages of all 17 (observed) values of the coeffi- /27
cients k, l, m, K, L, M of cosnλ and sinnλ, disregarding the signs, and they are given in Tables (5), (6) and (7). Accordingly, the average is:

TABLE (20)

terms calculated up to incl. for	λ_0	λ	2λ	3λ	4λ	5λ	6λ	7λ
P^{III}	± 51	73	50	33	27	(24)		
P^{IV}	± 44	38	39	34	26	20		
P^{V}	± 44	36	37	25	22	17	12	
P^{VI}	± 44	37	38	25	22	17	12	12
$\mathcal{Y}_n$	± 497	184	82	32	24	11	12	

From this follows the drop of the average difference between theory and observation.

from	λ_0	λ	2λ	3λ	4λ	5λ	6λ	sum of the drops
P^{III} to P^{IV}	-7	-35	-11	+1	-1			-53
P^{IV} " P^{V}	0	-2	-2	-9	-4	-3	0	-20
P^{V} " P^{VI}	0	+1	+1	0	0	0	0	+2

Thus, through consideration of P^V the difference between theory and observation is reduced in sum by 53, and through consideration of P^{VI}, the difference is reduced by a further 20 points, whereas P^{VII} no longer increases the agreement between computation and observation. From this we must conclude that neither the quantities P^I

through P^{IV} (Erman-Petersen, Neumeyer-Petersen, Quintus Teilus), nor P^{I} through P^{V} (A. Schmidt) are sufficient for the representation of the terrestrial magnetic large scale phenomena. Now if we assume that the average value of $\cos n\lambda$ and $\sin n\lambda = 1/2$, and if we insert the value ±24 into the horizontal row P^{IV} of Table (20) under 5λ, = the -$\mathcal{Y}_5$- of the same vertical column, while necessarily neglecting entirely the terms with $\cos 5\lambda$ and $\sin 5\lambda$ with their mean amount ±24, then on the average the mean deviation F of an X, Y, or Z, calculated by the theory, from the corresponding quantity determined by the magnetic chart (the observed X, Y or Z) is as follows:

when using
from P' up to P^{IV} $F_X = \pm 0{,}0564$ Gaussian units
P' P^{V} $F_Y = \pm 0{,}0483$ "
P' P^{VI} $F_Z = \pm 0{,}0387$ "

Excluding the 15 coefficients $g^{7,m}$ and $h^{7,m}$ or P^{VII}, and with the help of the remaining 48 values g, h of Table (19), and the numerical coefficients of $\cos n\lambda$ and $\sin n\lambda$ in the above equations $(X)_0$, $(Y)_0$, $(Z)_0$, $(X)_1$, $(Y)_1$, $(Z)_1$, $(X)_2$, $(Y)_2$, $(Z)_2$, $(X)_3$, $(Y)_3$, $(Z)_3$, I have derived the following equations (21), (22) and (23) in which the terms with $\cos 6\lambda$, $\sin 6\lambda$, $\cos 7\lambda$, $\sin 7\lambda$ are neglected, since they are small and uncertain.

Equations (21), computed according to the theory /28

φ	u		K_0	K_1 $\cos\lambda$	K_1 $\sin\lambda$	K_2 $\cos 2\lambda$	K_2 $\sin 2\lambda$	K_3 $\cos 3\lambda$	K_3 $\sin 3\lambda$	K_4 $\cos 4\lambda$	K_4 $\sin 4\lambda$	K_5 $\cos 5\lambda$	K_5 $\sin 5\lambda$
+85	5°	X =	+0,156	+0,242	+0,356	+0,104	+0,018	−0,001	−0,001	0,000	0,000	0,000	0,000
+80	10	X =	+0,313	+0,204	+0,382	+0,197	+0,034	−0,009	−0,004	0,000	−0,001	0,000	0,000
+70	20	X =	+0,720	+0,016	+0,425	+0,313	+0,060	−0,024	−0,009	−0,003	−0,001	0,000	+0,001
+60	30	X =	+1,216	−0,161	+0,473	+0,301	+0,078	−0,030	0,000	−0,007	−0,016	+0,003	+0,004
+50	40	X =	+1,784	−0,335	+0,454	+0,169	+0,055	+0,011	+0,027	−0,005	−0,023	+0,005	+0,011
+40	50	X =	+2,357	−0,196	+0,464	−0,018	+0,128	+0,051	+0,040	−0,001	−0,015	+0,009	+0,014
+30	60	X =	+2,858	−0,126	+0,383	−0,166	+0,148	+0,072	+0,031	+0,012	−0,005	+0,010	+0,011
+20	70	X =	+3,264	−0,119	+0,294	−0,270	+0,137	+0,063	+0,079	+0,022	+0,009	+0,007	+0,002
+10	80	X =	+3,572	−0,119	+0,219	−0,265	+0,092	+0,037	+0,060	+0,028	+0,017	+0,003	−0,010
0	90	X =	+3,745	−0,188	+0,163	−0,201	−0,007	+0,019	+0,031	+0,013	+0,013	−0,003	−0,019
−10	100	X =	+3,750	−0,539	+0,091	−0,129	−0,088	+0,019	+0,008	0,000	+0,005	−0,007	−0,018
−20	110	X =	+3,564	−0,585	−0,052	−0,080	−0,133	+0,025	−0,015	−0,011	+0,001	−0,009	−0,010
−30	120	X =	+3,182	−0,494	−0,279	−0,058	−0,134	+0,012	−0,033	−0,016	+0,001	−0,008	−0,001
−40	130	X =	+2,683	−0,260	−0,534	−0,024	−0,112	−0,017	−0,066	−0,013	+0,007	−0,005	+0,004
−50	140	X =	+1,902	+0,076	−0,714	+0,017	−0,093	−0,069	−0,081	−0,007	+0,009	−0,003	+0,005
−60	150	X =	+1,092	+0,453	−0,737	+0,067	−0,084	−0,084	−0,074	−0,003	+0,008	−0,001	+0,004
−70	160	X =	+0,484	+0,804	−0,617	+0,081	−0,072	−0,068	−0,047	−0,001	+0,004	0,000	+0,001
−80	170	X =	+0,141	+1,054	−0,454	+0,057	−0,044	−0,019	−0,014	0,000	+0,001	0,000	0,000
−85	175	X =	+0,038	+1,144	−0,383	+0,032	−0,024	−0,006	−0,002	0,000	0,000	0,000	0,000

Equations (22), computed according to the theory

φ	ω		ℓ_1 cos λ	ℓ_1 sin λ	ℓ_2 cos 2λ	ℓ_2 sin 2λ	ℓ_3 cos 3λ	ℓ_3 sin 3λ	ℓ_4 cos 4λ	ℓ_4 sin 4λ	ℓ_5 cos 5λ	ℓ_5 sin 5λ
+85°	5°	y =	+0,352	−0,255	+0,019	−0,105	−0,002	+0,002	0,000	0,000	0,000	0,000
+80	10	y =	+0,371	−0,258	+0,036	−0,206	−0,005	+0,009	−0,001	0,000	0,000	0,000
+70	20	y =	+0,393	−0,198	+0,067	−0,335	−0,011	+0,030	−0,002	+0,004	+0,001	0,000
+60	30	y =	+0,426	−0,103	+0,095	−0,486	−0,014	+0,045	−0,002	+0,010	+0,006	−0,003
+50	40	y =	+0,464	−0,015	+0,125	−0,505	−0,001	+0,040	−0,008	+0,015	+0,016	−0,007
+40	50	y =	+0,500	+0,029	+0,154	−0,458	+0,034	+0,013	−0,034	+0,016	+0,020	−0,015
+30	60	y =	+0,529	+0,054	+0,174	−0,362	+0,076	−0,027	−0,038	+0,009	+0,018	−0,021
+20	70	y =	+0,547	+0,074	+0,182	−0,247	+0,116	−0,064	−0,052	−0,004	+0,012	−0,019
+10	80	y =	+0,553	+0,089	+0,182	−0,138	+0,145	−0,089	−0,058	+0,005	+0,005	−0,013
0	90	y =	+0,549	+0,151	+0,178	−0,054	+0,167	−0,101	−0,058	−0,032	+0,002	−0,004
−10	100	y =	+0,537	+0,216	+0,168	+0,104	+0,172	−0,113	−0,052	−0,038	+0,005	−0,007
−20	110	y =	+0,663	+0,354	+0,232	+0,041	+0,184	−0,130	−0,032	−0,034	−0,008	−0,001
−30	120	y =	+0,635	+0,496	+0,292	+0,072	+0,184	−0,155	−0,024	−0,025	−0,014	−0,013
−40	130	y =	+0,582	+0,649	+0,340	+0,098	+0,172	−0,171	−0,024	−0,014	−0,014	−0,007
−50	140	y =	+0,640	+0,801	+0,359	+0,119	+0,145	−0,164	−0,018	−0,007	−0,008	−0,002
−60	150	y =	+0,566	+0,933	+0,313	+0,124	+0,102	−0,127	−0,010	−0,002	−0,004	−0,001
−70	160	y =	+0,477	+1,042	+0,235	+0,105	+0,053	−0,078	−0,004	0,000	−0,001	0,000
−80	170	y =	+0,407	+1,120	+0,096	+0,062	+0,015	−0,019	−0,001	0,000	0,000	0,000
−85	175	y =	+0,372	+1,170	+0,024	+0,033	+0,004	−0,004	0,000	0,000	0,000	0,000

Equations (23), computed according to the theory /29

φ	ω		m_0	m_1 cos λ	M_1 sin λ	m_2 cos 2λ	M_2 sin 2λ	m_3 cos 3λ	M_3 sin 3λ	m_4 cos 4λ	M_4 sin 4λ	m_5 cos 5λ	M_5 sin 5λ
+85°	5°	Z =	+5,582	−0,144	−0,029	−0,020	−0,002	+0,001	0,000	0,000	0,000	0,000	0,000
+80	10	Z =	+5,536	−0,286	−0,063	−0,038	−0,010	+0,004	+0,002	0,000	0,000	0,000	0,000
+70	20	Z =	+5,563	−0,538	−0,159	−0,086	−0,026	+0,026	+0,012	+0,003	+0,005	0,000	0,000
+60	30	Z =	+5,404	−0,747	−0,303	−0,125	−0,046	+0,056	+0,025	+0,008	+0,007	−0,002	−0,004
+50	40	Z =	+5,225	−0,944	−0,497	−0,139	−0,076	+0,068	+0,035	+0,018	+0,010	−0,006	−0,004
+40	50	Z =	+4,372	+0,008	−0,705	−0,716	−0,147	+0,042	−0,006	+0,023	+0,013	−0,014	−0,010
+30	60	Z =	+3,458	+0,855	−0,884	−0,593	−0,227	−0,021	−0,044	+0,018	+0,023	−0,024	−0,005
+20	70	Z =	+2,317	+0,817	−1,006	−0,384	−0,324	−0,084	−0,132	−0,001	+0,006	−0,034	−0,012
+10	80	Z =	+1,064	−0,005	−1,024	−0,169	−0,412	−0,120	−0,187	−0,025	+0,017	−0,040	−0,016
0	90	Z =	−0,206	+0,032	−1,159	−0,013	−0,440	−0,129	−0,219	−0,044	+0,023	−0,038	−0,016
−10	100	Z =	−1,328	+0,343	−1,258	+0,071	−0,358	−0,136	−0,233	−0,051	+0,021	−0,032	−0,008
−20	110	Z =	−2,403	+0,709	−1,348	+0,106	−0,312	−0,142	−0,236	−0,043	+0,014	−0,022	+0,004
−30	120	Z =	−3,252	+1,091	−1,344	+0,133	−0,223	−0,130	−0,228	−0,028	+0,003	−0,014	+0,011
−40	130	Z =	−3,962	+1,388	−1,167	+0,158	−0,159	−0,118	−0,202	−0,013	+0,007	−0,006	+0,015
−50	140	Z =	−4,613	+1,520	−0,831	+0,173	−0,121	−0,103	−0,149	−0,004	+0,010	−0,002	+0,008
−60	150	Z =	−5,248	+1,437	−0,417	+0,149	−0,092	−0,118	−0,085	0,000	+0,009	0,000	+0,002
−70	160	Z =	−5,835	+1,127	−0,105	+0,090	−0,054	−0,096	−0,032	+0,001	+0,003	0,000	0,000
−80	170	Z =	−6,266	+0,621	+0,021	+0,027	−0,016	−0,008	−0,004	0,000	0,000	0,000	0,000
−85	175	Z =	−6,370	+0,319	+0,022	+0,007	−0,004	0,000	0,000	0,000	0,000	0,000	0,000

With the aid of the equations (21), (22) and 23), I have computed the following tables (24), (25) and (26) for the components X, Y and Z, and from them I have derived the values of the declination δ, the horizontal intensity τ, and the inclination i, according to the formulas $X = \tau \cos\delta$, $Y = \tau \sin\delta$, and $Z = \tau \cdot tg \cdot i$.

TABLE (24) for the northern component X /30

For u = 0° or the astronomical North Pole, X = 0.3737 sin(λ+31°59')

For u = 180° or the astronomical South Pole, X = 1.2753cos(λ+15°9').

u	λ = / φ	0° X	7.5° X	15° X	22.5° X	30° X	37.5° X	45° X	52.5° X	60° X	67.5° X	75° X	82.5° X
0°	+90	+0,198	+0,238	+0,273	+0,303	+0,329	+0,349	+0,364	+0,372	+0,370	+0,369	+0,357	+0,346
5	+85	+0,301	+0,546	+0,579	+0,601	+0,611	+0,609	+0,597	+0,577	+0,550	+0,519	+0,484	+0,445
10	+80	+0,715	+0,764	+0,797	+0,814	+0,816	+0,801	+0,770	+0,729	+0,676	+0,648	+0,599	+0,553
15	+75	+0,875	+0,925	+0,959	+0,974	+0,974	+0,958	+0,929	+0,888	+0,839	+0,787	+0,736	+0,681
20	+70	+1,022	+1,078	+1,116	+1,135	+1,139	+1,129	+1,105	+1,068	+1,023	+0,973	+0,922	+0,876
25	+65	+1,171	+1,233	+1,279	+1,306	+1,318	+1,318	+1,305	+1,279	+1,244	+1,202	+1,159	+1,119
30	+60	+1,332	+1,402	+1,457	+1,495	+1,519	+1,531	+1,531	+1,520	+1,499	+1,470	+1,438	+1,408
35	+55	+1,521	+1,601	+1,668	+1,718	+1,754	+1,779	+1,793	+1,796	+1,791	+1,778	+1,760	+1,741
40	+50	+1,730	+1,821	+1,900	+1,962	+2,011	+2,048	+2,075	+2,093	+2,103	+2,106	+2,103	+2,094
45	+45	+1,964	+2,066	+2,157	+2,233	+2,289	+2,335	+2,373	+2,403	+2,425	+2,442	+2,451	+2,450
50	+40	+2,202	+2,313	+2,414	+2,496	+2,564	+2,619	+2,665	+2,705	+2,738	+2,766	+2,785	+2,792
55	+35	+2,429	+2,548	+2,656	+2,744	+2,818	+2,880	+2,933	+2,981	+3,022	+3,059	+3,086	+3,100
60	+30	+2,632	+2,754	+2,866	+2,952	+3,037	+3,104	+3,163	+3,218	+3,266	+3,309	+3,343	+3,362
65	+25	+2,793	+2,911	+3,023	+3,117	+3,201	+3,273	+3,337	+3,397	+3,451	+3,498	+3,536	+3,560
70	+20	+2,906	+3,015	+3,122	+3,217	+3,304	+3,380	+3,445	+3,514	+3,573	+3,625	+3,667	+3,697
75	+15	+2,955	+3,052	+3,150	+3,262	+3,329	+3,410	+3,485	+3,556	+3,621	+3,679	+3,728	+3,766
80	+10	+2,950	+3,030	+3,115	+3,201	+3,287	+3,371	+3,453	+3,530	+3,602	+3,667	+3,724	+3,772
85	+5	+2,888	+2,946	+3,014	+3,092	+3,176	+3,262	+3,349	+3,432	+3,512	+3,586	+3,654	+3,714
90	0	+2,785	+2,819	+2,868	+2,935	+3,014	+3,100	+3,190	+3,278	+3,365	+3,448	+3,528	+3,603
95	-5	+2,649	+2,662	+2,693	+2,746	+2,816	+2,898	+2,988	+3,078	+3,169	+3,260	+3,350	+3,441
100	-10	+2,494	+2,488	+2,501	+2,539	+2,596	+2,671	+2,756	+2,845	+2,938	+3,034	+3,133	+3,231
105	-15	+2,333	+2,310	+2,306	+2,327	+2,369	+2,430	+2,505	+2,589	+2,681	+2,780	+2,885	+3,001
110	-20	+2,180	+2,139	+2,118	+2,122	+2,147	+2,192	+2,253	+2,327	+2,414	+2,512	+2,620	+2,741
115	-25	+2,045	+1,990	+1,951	+1,937	+1,945	+1,973	+2,019	+2,079	+2,155	+2,246	+2,349	+2,465
120	-30	+1,946	+1,870	+1,813	+1,781	+1,770	+1,780	+1,809	+1,853	+1,914	+1,992	+2,085	+2,187
125	-35	+1,885	+1,792	+1,717	+1,666	+1,636	+1,626	+1,636	+1,664	+1,708	+1,768	+1,841	+1,924
130	-40	+1,860	+1,751	+1,660	+1,590	+1,540	+1,511	+1,501	+1,510	+1,534	+1,572	+1,621	+1,677
135	-45	+1,876	+1,753	+1,646	+1,558	+1,490	+1,442	+1,412	+1,398	+1,397	+1,409	+1,430	+1,455
140	-50	+1,916	+1,782	+1,662	+1,557	+1,473	+1,407	+1,356	+1,318	+1,291	+1,274	+1,264	+1,256
145	-55	+1,971	+1,832	+1,703	+1,588	+1,487	+1,403	+1,331	+1,265	+1,216	+1,169	+1,125	+1,081
150	-60	+2,018	+1,879	+1,746	+1,622	+1,509	+1,408	+1,317	+1,232	+1,153	+1,077	+1,005	+0,934
155	-65	+2,037	+1,505	+1,774	+1,645	+1,522	+1,407	+1,297	+1,191	+1,088	+0,987	+0,888	+0,791
160	-70	+2,008	+1,889	+1,764	+1,635	+1,506	+1,379	+1,254	+1,130	+1,006	+0,883	+0,762	+0,644
165	-75	+1,903	+1,800	+1,687	+1,562	+1,432	+1,298	+1,162	+1,025	+0,885	+0,745	+0,608	+0,476
170	-80	+1,733	+1,648	+1,546	+1,431	+1,305	+1,168	+1,024	+0,876	+0,726	+0,576	+0,427	+0,282
175	-85	+1,505	+1,438	+1,351	+1,245	+1,124	+0,991	+0,847	+0,695	+0,537	+0,378	+0,219	+0,064
180	-90	+1,231	+1,177	+1,103	+1,010	+0,900	+0,774	+0,635	+0,485	+0,327	+0,164	-0,002	-0,169
	λ =	0°	7.5°	15°	22.5°	30°	37.5°	45°	52.5°	60°	67.5°	75°	82.5°

TABLE (24) for the northern component X /31

ϑ	λ = φ'	90° X	97,5 X	105° X	112,5 X	120° X	127,5 X	135° X	142,5 X	150° X	157,5 X	165° X	172,5 X
0°	+90°	+0,317	+0,288	+0,255	+0,217	+0,176	+0,131	+0,086	+0,036	-0,013	-0,061	-0,109	-0,155
5	+85	+0,407	+0,373	+0,338	+0,305	+0,274	+0,248	+0,217	+0,188	+0,159	+0,128	+0,095	+0,059
10	+80	+0,512	+0,496	+0,477	+0,421	+0,416	+0,409	+0,406	+0,406	+0,404	+0,396	+0,381	+0,358
15	+75	+0,642	+0,617	+0,597	+0,592	+0,600	+0,617	+0,646	+0,673	+0,698	+0,714	+0,720	+0,706
20	+70	+0,839	+0,815	+0,806	+0,815	+0,841	+0,881	+0,929	+0,977	+1,021	+1,055	+1,074	+1,067
25	+65	+1,089	+1,072	+1,078	+1,092	+1,131	+1,185	+1,246	+1,366	+1,359	+1,399	+1,419	+1,400
30	+60	+1,385	+1,376	+1,382	+1,409	+1,453	+1,513	+1,579	+1,641	+1,698	+1,738	+1,743	+1,728
35	+55	+1,725	+1,721	+1,728	+1,754	+1,796	+1,850	+1,910	+1,964	+2,007	+2,028	+2,026	+1,997
40	+50	+2,026	+2,023	+2,039	+2,109	+2,141	+2,183	+2,227	+2,265	+2,289	+2,290	+2,270	+2,224
45	+45	+2,447	+2,444	+2,445	+2,453	+2,470	+2,493	+2,515	+2,529	+2,528	+2,505	+2,461	+2,402
50	+40	+2,792	+2,787	+2,781	+2,776	+2,774	+2,775	+2,771	+2,757	+2,730	+2,682	+2,620	+2,507
55	+35	+3,102	+3,094	+3,079	+3,060	+3,037	+3,013	+2,982	+2,942	+2,890	+2,823	+2,748	+2,669
60	+30	+3,367	+3,357	+3,335	+3,303	+3,262	+3,215	+3,161	+3,097	+3,025	+2,946	+2,862	+2,784
65	+25	+3,564	+3,560	+3,535	+3,497	+3,445	+3,383	+3,313	+3,234	+3,150	+3,064	+2,983	+2,909
70	+20	+3,712	+3,707	+3,685	+3,646	+3,591	+3,521	+3,441	+3,356	+3,268	+3,185	+3,106	+3,046
75	+15	+3,790	+3,795	+3,783	+3,753	+3,704	+3,637	+3,559	+3,474	+3,387	+3,306	+3,241	+3,192
80	+10	+3,808	+3,828	+3,832	+3,817	+3,782	+3,727	+3,655	+3,578	+3,501	+3,430	+3,371	+3,332
85	+5	+3,766	+3,807	+3,833	+3,839	+3,825	+3,787	+3,732	+3,667	+3,601	+3,540	+3,490	+3,457
90	0	+3,672	+3,735	+3,785	+3,816	+3,827	+3,811	+3,776	+3,724	+3,670	+3,621	+3,578	+3,549
95	-5	+3,529	+3,615	+3,690	+3,746	+3,782	+3,786	+3,770	+3,736	+3,694	+3,654	+3,618	+3,590
100	-10	+3,344	+3,450	+3,547	+3,625	+3,682	+3,707	+3,710	+3,692	+3,662	+3,630	+3,601	+3,576
105	-15	+3,120	+3,240	+3,352	+3,445	+3,520	+3,560	+3,580	+3,572	+3,554	+3,531	+3,508	+3,486
110	-20	+2,866	+2,993	+3,112	+3,213	+3,292	+3,344	+3,375	+3,384	+3,379	+3,368	+3,354	+3,341
115	-25	+2,586	+2,708	+2,824	+2,923	+3,004	+3,062	+3,102	+3,124	+3,135	+3,140	+3,142	+3,143
120	-30	+2,295	+2,404	+2,508	+2,598	+2,674	+2,733	+2,779	+2,814	+2,842	+2,866	+2,887	+2,907
125	-35	+2,010	+2,097	+2,180	+2,253	+2,317	+2,371	+2,420	+2,467	+2,512	+2,558	+2,603	+2,649
130	-40	+1,736	+1,794	+1,851	+1,902	+1,950	+1,997	+2,047	+2,103	+2,164	+2,231	+2,302	+2,376
135	-45	+1,482	+1,508	+1,535	+1,562	+1,593	+1,632	+1,682	+1,745	+1,819	+1,906	+2,000	+2,096
140	-50	+1,250	+1,243	+1,240	+1,243	+1,257	+1,286	+1,332	+1,398	+1,481	+1,582	+1,692	+1,802
145	-55	+1,043	+1,013	+0,984	+0,965	+0,960	+0,977	+1,018	+1,081	+1,164	+1,263	+1,382	+1,497
150	-60	+0,867	+0,805	+0,753	+0,714	+0,693	+0,697	+0,725	+0,779	+0,855	+0,952	+1,060	+1,172
155	-65	+0,700	+0,616	+0,543	+0,486	+0,448	+0,437	+0,449	+0,487	+0,547	+0,627	+0,719	+0,817
160	-70	+0,533	+0,434	+0,340	+0,266	+0,212	+0,183	+0,176	+0,194	+0,232	+0,290	+0,360	+0,438
165	-75	+0,349	+0,234	+0,128	+0,040	-0,030	-0,078	-0,106	-0,110	-0,099	-0,063	-0,021	+0,036
170	-80	+0,154	+0,017	-0,099	-0,201	-0,288	-0,335	-0,404	-0,434	-0,449	-0,440	-0,422	-0,386
175	-85	-0,085	-0,226	-0,357	-0,474	-0,577	-0,664	-0,735	-0,788	-0,824	-0,840	-0,839	-0,821
180	-90	-0,333	-0,491	-0,640	-0,778	-0,903	-1,012	-1,105	-1,178	-1,232	-1,264	-1,275	-1,264
	λ =	90°	97,5	105°	112,5	120°	127,5	135°	142,5	150°	157,5	165°	172,5

TABLE (24) for the northern component X

u°	φ°	λ = 180° X	187,5° X	195° X	202,5° X	210° X	217,5° X	225° X	232,5° X	240° X	247,5° X	255° X	262,5° X
0	+90	−0,198	−0,238	−0,273	−0,305	−0,329	−0,349	−0,366	−0,372	−0,379	−0,369	−0,387	−0,390
5	+85	+0,019	−0,024	−0,069	−0,116	−0,163	−0,207	−0,249	−0,283	−0,310	−0,328	−0,339	−0,326
10	+80	+0,325	+0,279	+0,233	+0,152	+0,088	+0,014	−0,060	−0,129	−0,188	−0,236	−0,263	−0,271
15	+75	+0,681	+0,630	+0,563	+0,482	+0,388	+0,289	+0,186	+0,087	−0,008	−0,078	−0,136	−0,166
20	+70	+1,038	+0,985	+0,910	+0,815	+0,705	+0,585	+0,461	+0,339	+0,225	+0,127	+0,041	−0,003
25	+65	+1,378	+1,319	+1,239	+1,138	+1,021	+0,893	+0,759	+0,624	+0,495	+0,380	+0,284	+0,216
30	+60	+1,682	+1,624	+1,541	+1,441	+1,327	+1,202	+1,071	+0,935	+0,803	+0,680	+0,572	+0,488
35	+55	+1,946	+1,877	+1,795	+1,704	+1,605	+1,499	+1,388	+1,269	+1,145	+1,031	+0,918	+0,828
40	+50	+2,162	+2,091	+2,016	+1,939	+1,863	+1,786	+1,705	+1,613	+1,515	+1,410	+1,307	+1,211
45	+45	+2,332	+2,264	+2,200	+2,147	+2,102	+2,050	+2,019	+1,956	+1,887	+1,804	+1,715	+1,623
50	+40	+2,474	+2,412	+2,365	+2,336	+2,322	+2,316	+2,307	+2,285	+2,248	+2,191	+2,121	+2,040
55	+35	+2,595	+2,546	+2,515	+2,511	+2,524	+2,543	+2,572	+2,583	+2,579	+2,550	+2,503	+2,435
60	+30	+2,720	+2,678	+2,664	+2,679	+2,713	+2,760	+2,809	+2,840	+2,872	+2,871	+2,847	+2,798
65	+25	+2,856	+2,826	+2,823	+2,852	+2,892	+2,956	+3,011	+3,074	+3,117	+3,136	+3,131	+3,097
70	+20	+3,004	+2,986	+2,990	+3,020	+3,066	+3,127	+3,191	+3,254	+3,307	+3,340	+3,349	+3,328
75	+15	+3,160	+3,148	+3,156	+3,181	+3,220	+3,268	+3,322	+3,375	+3,420	+3,468	+3,485	+3,474
80	+10	+3,302	+3,300	+3,305	+3,320	+3,343	+3,374	+3,411	+3,454	+3,496	+3,532	+3,552	+3,545
85	+5	+3,416	+3,426	+3,423	+3,424	+3,428	+3,435	+3,455	+3,480	+3,507	+3,535	+3,550	+3,541
90	0	+3,529	+3,514	+3,501	+3,487	+3,474	+3,464	+3,460	+3,467	+3,479	+3,492	+3,497	+3,482
95	−5	+3,566	+3,545	+3,523	+3,498	+3,472	+3,447	+3,428	+3,420	+3,417	+3,412	+3,408	+3,384
100	−10	+3,547	+3,522	+3,495	+3,463	+3,430	+3,397	+3,368	+3,348	+3,332	+3,315	+3,297	+3,263
105	−15	+3,463	+3,439	+3,414	+3,383	+3,357	+3,318	+3,288	+3,262	+3,236	+3,208	+3,180	+3,137
110	−20	+3,336	+3,310	+3,292	+3,265	+3,243	+3,218	+3,191	+3,163	+3,134	+3,100	+3,062	+3,014
115	−25	+3,149	+3,140	+3,136	+3,128	+3,115	+3,101	+3,081	+3,051	+3,030	+2,995	+2,955	+2,901
120	−30	+2,926	+2,943	+2,957	+2,966	+2,970	+2,968	+2,959	+2,944	+2,922	+2,890	+2,854	+2,816
125	−35	+2,693	+2,734	+2,769	+2,797	+2,817	+2,828	+2,830	+2,821	+2,807	+2,785	+2,762	+2,740
130	−40	+2,444	+2,503	+2,564	+2,609	+2,644	+2,667	+2,679	+2,679	+2,674	+2,668	+2,663	+2,662
135	−45	+2,185	+2,268	+2,341	+2,398	+2,443	+2,479	+2,496	+2,507	+2,516	+2,528	+2,544	+2,568
140	−50	+1,908	+2,005	+2,090	+2,15[illegible]	+2,207	+2,266	+2,286	+2,300	+2,325	+2,357	+2,396	+2,447
145	−55	+1,609	+1,711	+1,801	+1,871	+1,927	+1,973	+2,011	+2,047	+2,088	+2,141	+2,206	+2,283
150	−60	+1,282	+1,383	+1,472	+1,544	+1,605	+1,657	+1,705	+1,755	+1,813	+1,886	+1,973	+2,077
155	−65	+0,915	+1,007	+1,092	+1,165	+1,231	+1,292	+1,353	+1,420	+1,496	+1,589	+1,696	+1,820
160	−70	+0,520	+0,600	+0,678	+0,752	+0,824	+0,896	+0,972	+1,057	+1,152	+1,264	+1,388	+1,526
165	−75	+0,101	+0,170	+0,249	+0,314	+0,398	+0,485	+0,576	+0,678	+0,791	+0,920	+1,052	+1,206
170	−80	−0,337	−0,278	−0,208	−0,128	−0,039	+0,060	+0,170	+0,290	+0,420	+0,562	+0,711	+0,867
175	−85	−0,785	−0,732	−0,663	−0,578	−0,470	−0,365	−0,239	−0,102	+0,045	+0,198	+0,359	+0,517
180	−90	−1,231	−1,177	−1,123	−1,010	−0,900	−0,774	−0,635	−0,485	−0,327	−0,164	+0,002	+0,169
	λ =	180°	187,5°	195°	202,5°	210°	217,5°	225°	232,5°	240°	247,5°	255°	262,5°

TABLE (24) for the northern component X /33

u	λ = / φ	270° X	277.5° X	285° X	292.5° X	300° X	307.5° X	315° X	322.5° X	330° X	337.5° X	345° X	352.5° = λ X
0°	+90°	-0,327	-0,288	-0,255	-0,217	-0,176	-0,131	-0,084	-0,036	+0,013	+0,061	+0,109	+0,155
5	+85	-0,305	-0,271	-0,224	-0,166	-0,098	-0,022	+0,059	+0,142	+0,225	+0,305	+0,379	+0,446
10	+80	-0,260	-0,225	-0,179	-0,109	-0,024	+0,070	+0,172	+0,279	+0,384	+0,482	+0,571	+0,650
15	+75	-0,174	-0,152	-0,106	-0,035	+0,056	+0,161	+0,276	+0,396	+0,513	+0,621	+0,719	+0,804
20	+70	-0,031	-0,022	+0,016	+0,082	+0,171	+0,278	+0,397	+0,521	+0,643	+0,757	+0,860	+0,949
25	+65	+0,171	+0,164	+0,189	+0,245	+0,325	+0,426	+0,540	+0,660	+0,781	+0,896	+1,002	+1,094
30	+60	+0,431	+0,407	+0,416	+0,456	+0,521	+0,609	+0,711	+0,821	+0,937	+1,048	+1,155	+1,249
35	+55	+0,758	+0,717	+0,706	+0,724	+0,768	+0,836	+0,920	+1,015	+1,118	+1,225	+1,330	+1,429
40	+50	+1,130	+1,074	+1,041	+1,035	+1,053	+1,095	+1,157	+1,233	+1,321	+1,420	+1,524	+1,629
45	+45	+1,538	+1,469	+1,416	+1,383	+1,371	+1,384	+1,418	+1,472	+1,544	+1,637	+1,742	+1,853
50	+40	+1,956	+1,876	+1,805	+1,746	+1,704	+1,685	+1,689	+1,720	+1,776	+1,862	+1,966	+2,081
55	+35	+2,360	+2,274	+2,187	+2,105	+2,036	+1,986	+1,960	+1,968	+2,008	+2,084	+2,185	+2,304
60	+30	+2,729	+2,641	+2,543	+2,442	+2,358	+2,271	+2,219	+2,205	+2,235	+2,304	+2,388	+2,506
65	+25	+3,037	+2,951	+2,848	+2,733	+2,621	+2,524	+2,453	+2,421	+2,429	+2,481	+2,564	+2,672
70	+20	+3,278	+3,195	+3,091	+2,969	+2,845	+2,735	+2,649	+2,604	+2,596	+2,633	+2,702	+2,797
75	+15	+3,432	+3,357	+3,253	+3,129	+3,000	+2,884	+2,790	+2,734	+2,713	+2,734	+2,788	+2,864
80	+10	+3,509	+3,438	+3,340	+3,219	+3,092	+2,977	+2,881	+2,817	+2,785	+2,791	+2,825	+2,880
85	+5	+3,506	+3,438	+3,346	+3,233	+3,115	+3,007	+2,916	+2,851	+2,812	+2,802	+2,813	+2,843
90	0	+3,445	+3,379	+3,293	+3,191	+3,085	+2,988	+2,904	+2,842	+2,798	+2,771	+2,760	+2,765
95	-5	+3,341	+3,276	+3,195	+3,103	+3,008	+2,923	+2,847	+2,786	+2,737	+2,697	+2,668	+2,652
100	-10	+3,214	+3,149	+3,073	+2,991	+2,908	+2,834	+2,766	+2,706	+2,652	+2,600	+2,555	+2,518
105	-15	+3,084	+3,020	+2,950	+2,879	+2,807	+2,742	+2,680	+2,618	+2,557	+2,494	+2,433	+2,377
110	-20	+2,960	+2,900	+2,838	+2,778	+2,718	+2,660	+2,601	+2,536	+2,467	+2,392	+2,316	+2,242
115	-25	+2,860	+2,808	+2,755	+2,709	+2,656	+2,602	+2,549	+2,479	+2,399	+2,310	+2,218	+2,128
120	-30	+2,777	+2,739	+2,702	+2,668	+2,630	+2,584	+2,525	+2,448	+2,358	+2,255	+2,147	+2,042
125	-35	+2,719	+2,702	+2,686	+2,668	+2,642	+2,601	+2,543	+2,459	+2,358	+2,241	+2,118	+1,999
130	-40	+2,664	+2,673	+2,681	+2,682	+2,670	+2,632	+2,581	+2,465	+2,384	+2,257	+2,122	+1,987
135	-45	+2,598	+2,635	+2,671	+2,695	+2,703	+2,682	+2,632	+2,547	+2,437	+2,304	+2,160	+2,018
140	-50	+2,506	+2,573	+2,636	+2,686	+2,715	+2,710	+2,672	+2,596	+2,491	+2,359	+2,212	+2,062
145	-55	+2,370	+2,465	+2,554	+2,629	+2,681	+2,697	+2,677	+2,617	+2,525	+2,405	+2,266	+2,119
150	-60	+2,189	+2,308	+2,420	+2,517	+2,591	+2,631	+2,633	+2,595	+2,523	+2,421	+2,298	+2,161
155	-65	+1,951	+2,081	+2,220	+2,336	+2,430	+2,491	+2,518	+2,506	+2,460	+2,386	+2,284	+2,166
160	-70	+1,671	+1,821	+1,966	+2,096	+2,206	+2,287	+2,338	+2,352	+2,332	+2,283	+2,211	+2,116
165	-75	+1,361	+1,515	+1,667	+1,804	+1,922	+2,021	+2,095	+2,121	+2,130	+2,106	+2,061	+1,992
170	-80	+1,024	+1,180	+1,332	+1,467	+1,590	+1,693	+1,774	+1,830	+1,861	+1,865	+1,844	+1,799
175	-85	+0,677	+0,833	+0,981	+1,119	+1,243	+1,350	+1,439	+1,507	+1,554	+1,576	+1,575	+1,551
180	-90	+0,333	+0,491	+0,640	+0,778	+0,903	+1,012	+1,105	+1,178	+1,232	+1,264	+1,275	+1,264
	λ =	270°	277.5°	285°	292.5°	300°	307.5°	315°	322.5°	330°	337.5°	345°	352.5° = λ

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TABLE (25) for the western component Y /34

For u = 0 or the astronomical North Pole Y = 0.3737cos(λ+31°59')

For u = 180° or the astronomical South Pole Y = 1.2753sin(λ+15°9').

u	λ = / φ	0° Y	7.5° Y	15° Y	22.5° Y	30° Y	37.5° Y	45° Y	52.5° Y	60° Y	67.5° Y	75° Y	82.5° = λ Y
0°	+90°	+0,317	+0,288	+0,255	+0,217	+0,176	+0,131	+0,084	+0,036	-0,013	-0,061	-0,109	-0,155
5	+85	+0,371	+0,307	+0,238	+0,168	+0,098	+0,030	-0,034	-0,098	-0,163	-0,186	-0,223	-0,253
10	+80	+0,400	+0,313	+0,221	+0,130	+0,041	-0,041	-0,118	-0,178	-0,229	-0,265	-0,289	-0,302
15	+75	+0,421	+0,319	+0,213	+0,107	+0,004	-0,087	-0,167	-0,235	-0,285	-0,315	-0,337	-0,338
20	+70	+0,442	+0,330	+0,216	+0,099	-0,011	-0,110	-0,195	-0,265	-0,315	-0,341	-0,346	-0,329
25	+65	+0,464	+0,347	+0,225	+0,105	-0,009	-0,112	-0,201	-0,273	-0,324	-0,351	-0,353	-0,329
30	+60	+0,491	+0,370	+0,245	+0,123	+0,008	-0,098	-0,190	-0,264	-0,317	-0,346	-0,349	-0,321
35	+55	+0,525	+0,403	+0,276	+0,153	+0,036	-0,072	-0,166	-0,242	-0,298	-0,329	-0,334	-0,307
40	+50	+0,564	+0,442	+0,315	+0,191	+0,072	-0,037	-0,132	-0,210	-0,268	-0,303	-0,311	-0,289
45	+45	+0,610	+0,487	+0,358	+0,231	+0,109	+0,001	-0,092	-0,171	-0,231	-0,269	-0,283	-0,267
50	+40	+0,660	+0,537	+0,405	+0,274	+0,145	+0,042	-0,050	-0,128	-0,189	-0,233	-0,251	-0,245
55	+35	+0,715	+0,593	+0,457	+0,322	+0,193	+0,083	-0,009	-0,086	-0,147	-0,195	-0,223	-0,225
60	+30	+0,771	+0,651	+0,511	+0,371	+0,237	+0,125	+0,031	-0,045	-0,106	-0,158	-0,193	-0,205
65	+25	+0,826	+0,706	+0,562	+0,413	+0,279	+0,166	+0,071	-0,006	-0,067	-0,123	-0,163	-0,185
70	+20	+0,879	+0,758	+0,612	+0,464	+0,322	+0,208	+0,112	+0,035	-0,028	-0,087	-0,133	-0,165
75	+15	+0,927	+0,808	+0,662	+0,513	+0,370	+0,254	+0,157	+0,070	+0,014	-0,050	-0,103	-0,143
80	+10	+0,969	+0,854	+0,710	+0,563	[illegible]	+0,303	+0,207	+0,128	+0,059	-0,009	-0,069	-0,117
85	+ 5	+1,001	+0,894	+0,757	+0,613	+0,47[illegible]	+0,358	+0,262	+0,181	+0,108	+0,036	-0,029	-0,082
90	0	+1,024	+0,928	+0,800	+0,663	+0,528	+0,417	+0,321	+0,237	+0,162	+0,087	+0,019	-0,038
95	-5	+1,039	+0,956	+0,837	+0,710	+0,584	+0,477	+0,382	+0,295	+0,218	+0,144	+0,077	+0,020
100	-10	+1,047	+0,978	+0,870	+0,756	+0,640	+0,538	+0,445	+0,359	+0,281	+0,209	+0,144	+0,088
105	-15	+1,049	+0,992	+0,900	+0,801	+0,696	+0,602	+0,513	+0,430	+0,353	+0,282	+0,220	+0,166
110	-20	+1,045	+1,000	+0,925	+0,841	+0,750	+0,664	+0,581	+0,503	+0,430	+0,363	+0,304	+0,255
115	-25	+1,037	+1,005	+0,946	+0,876	+0,797	+0,721	+0,646	+0,576	+0,510	+0,451	+0,399	+0,356
120	-30	+1,023	+1,006	+0,962	+0,905	+0,840	+0,775	+0,710	+0,649	+0,592	+0,543	+0,499	+0,461
125	-35	+1,003	+1,002	+0,974	+0,933	+0,881	+0,828	+0,774	+0,723	+0,676	+0,636	+0,599	+0,566
130	-40	+0,976	+0,992	+0,981	+0,955	+0,918	+0,877	+0,835	+0,796	+0,759	+0,728	+0,697	+0,668
135	-45	+0,942	+0,975	+0,981	+0,970	+0,948	+0,921	+0,892	+0,865	+0,840	+0,817	+0,792	+0,764
140	-50	+0,896	+0,948	+0,972	+0,978	+0,972	+0,960	+0,945	+0,931	+0,916	+0,901	+0,881	+0,851
145	-55	+0,837	+0,907	+0,952	+0,976	+0,989	+0,995	+0,995	+0,993	+0,986	+0,977	+0,959	+0,928
150	-60	+0,767	+0,857	+0,923	+0,967	+1,000	+1,024	+1,039	+1,048	+1,049	+1,043	+1,026	+0,993
155	-65	+0,689	+0,798	+0,886	+0,952	+1,005	+1,046	+1,075	+1,094	+1,102	+1,098	+1,080	+1,045
160	-70	+0,610	+0,736	+0,843	+0,931	+1,003	+1,059	+1,101	+1,130	+1,144	+1,142	+1,123	+1,086
165	-75	+0,536	+0,675	+0,795	+0,903	+0,990	+1,061	+1,115	+1,151	+1,172	+1,172	+1,155	+1,120
170	-80	+0,467	+0,615	+0,750	+0,869	+0,970	+1,054	+1,119	+1,164	+1,192	+1,195	+1,180	+1,147
175	-85	+0,400	+0,555	+0,699	+0,829	+0,944	+1,040	+1,117	+1,175	+1,212	+1,226	+1,220	+1,195
180	-90	+0,333	+0,491	+0,640	+0,778	+0,903	+1,012	+1,105	+1,178	+1,232	+1,264	+1,275	+1,264
	λ =	0°	7.5°	15°	22.5°	30°	37.5°	45°	52.5°	60°	67.5°	75°	82.5° = λ

TABLE (25) for the western component Y /35

u°	λ = / φ°	90° Y	97,5° Y	105° Y	112,5° Y	120° Y	127,5° Y	135° Y	142,5° Y	150° Y	157,5° Y	165° Y	172,5° Y
0	+90	-0,198	-0,238	-0,273	-0,303	-0,329	-0,349	-0,364	-0,372	-0,374	-0,369	-0,357	-0,340
5	+85	-0,276	-0,292	-0,301	-0,311	-0,317	-0,321	-0,324	-0,327	-0,330	-0,334	-0,336	-0,338
10	+80	-0,304	-0,296	-0,283	-0,268	-0,253	-0,242	-0,235	-0,237	-0,245	-0,261	-0,281	-0,306
15	+75	-0,305	-0,279	-0,238	-0,198	-0,165	-0,137	-0,121	-0,123	-0,142	-0,172	-0,216	-0,269
20	+70	-0,295	-0,245	-0,188	-0,127	-0,073	-0,035	-0,015	-0,019	-0,045	-0,095	-0,162	-0,241
25	+65	-0,283	-0,217	-0,143	-0,064	+0,008	+0,055	+0,077	+0,071	+0,036	-0,039	-0,122	-0,229
30	+60	-0,268	-0,191	-0,103	-0,010	+0,073	+0,129	+0,156	+0,143	+0,094	+0,009	-0,099	-0,220
35	+55	-0,253	-0,170	-0,074	+0,028	+0,120	+0,182	+0,210	+0,191	+0,131	+0,030	-0,095	-0,230
40	+50	-0,237	-0,153	-0,053	+0,054	+0,150	+0,215	+0,242	+0,215	+0,144	+0,029	-0,109	-0,253
45	+45	-0,221	-0,140	-0,040	+0,069	+0,166	+0,225	+0,251	+0,213	+0,130	+0,004	-0,143	-0,289
50	+40	-0,207	-0,132	-0,037	+0,070	+0,165	+0,224	+0,240	+0,191	+0,099	-0,037	-0,187	-0,330
55	+35	-0,198	-0,132	-0,047	+0,054	+0,144	+0,197	+0,207	+0,151	+0,057	-0,087	-0,236	-0,369
60	+30	-0,190	-0,137	-0,063	+0,028	+0,110	+0,157	+0,161	+0,100	-0,003	-0,141	-0,285	-0,406
65	+25	-0,183	-0,144	-0,083	-0,003	+0,069	+0,109	+0,107	+0,042	-0,061	-0,194	-0,329	-0,438
70	+20	-0,175	-0,150	-0,103	-0,035	+0,026	+0,056	+0,048	-0,019	-0,120	-0,246	-0,370	-0,460
75	+15	-0,164	-0,153	-0,119	-0,065	-0,017	+0,002	-0,014	-0,081	-0,178	-0,296	-0,405	-0,480
80	+10	-0,147	-0,146	-0,127	-0,088	-0,053	-0,047	-0,071	-0,139	-0,231	-0,338	-0,436	-0,496
85	+5	-0,119	-0,128	-0,121	-0,097	-0,077	-0,082	-0,114	-0,185	-0,274	-0,373	-0,460	-0,510
90	0	-0,080	-0,097	-0,101	-0,092	-0,088	-0,106	-0,147	-0,223	-0,312	-0,404	-0,482	-0,524
95	-5	-0,025	-0,048	-0,062	-0,069	-0,084	-0,113	-0,174	-0,256	-0,347	-0,435	-0,507	-0,543
100	-10	+0,043	+0,015	-0,008	-0,032	-0,065	-0,120	-0,191	-0,283	-0,378	-0,465	-0,534	-0,567
105	-15	+0,123	+0,091	+0,060	+0,021	-0,031	-0,106	-0,196	-0,301	-0,405	-0,495	-0,564	-0,596
110	-20	+0,213	+0,178	+0,138	+0,084	+0,014	-0,082	-0,191	-0,311	-0,426	-0,522	-0,593	-0,627
115	-25	+0,315	+0,275	+0,226	+0,156	+0,066	-0,051	-0,180	-0,315	-0,442	-0,545	-0,621	-0,656
120	-30	+0,422	+0,377	+0,317	+0,232	+0,122	-0,014	-0,162	-0,312	-0,450	-0,561	-0,642	-0,680
125	-35	+0,528	+0,477	+0,407	+0,307	+0,181	+0,028	-0,136	-0,300	-0,447	-0,568	-0,652	-0,693
130	-40	+0,629	+0,572	+0,493	+0,380	+0,240	+0,075	-0,101	-0,276	-0,434	-0,559	-0,647	-0,692
135	-45	+0,721	+0,658	+0,570	+0,447	+0,295	+0,125	-0,058	-0,236	-0,397	-0,526	-0,620	-0,669
140	-50	+0,805	+0,735	+0,639	+0,510	+0,356	+0,177	-0,005	-0,183	-0,344	-0,475	-0,574	-0,630
145	-55	+0,878	+0,803	+0,702	+0,570	+0,414	+0,233	+0,058	-0,117	-0,276	-0,407	-0,510	-0,574
150	-60	+0,940	+0,861	+0,758	+0,626	+0,473	+0,303	+0,129	-0,040	-0,196	-0,327	-0,433	-0,508
155	-65	+0,985	+0,908	+0,806	+0,678	+0,533	+0,372	+0,208	+0,048	-0,103	-0,234	-0,345	-0,433
160	-70	+1,029	+0,949	+0,849	+0,728	+0,592	+0,443	+0,289	+0,138	-0,005	-0,139	-0,257	-0,359
165	-75	+1,059	+0,981	+0,890	+0,775	+0,645	+0,512	+0,366	+0,221	+0,077	-0,054	-0,180	-0,298
170	-80	+1,092	+1,020	+0,930	+0,824	+0,705	+0,578	+0,441	+0,300	+0,158	+0,019	-0,118	-0,250
175	-85	+1,150	+1,083	+1,003	+0,903	+0,750	+0,665	+0,531	+0,389	+0,242	+0,093	-0,057	-0,206
180	-90	+1,231	+1,177	+1,103	+1,010	+0,900	+0,774	+0,635	+0,485	+0,327	+0,164	-0,002	-0,169
	λ =	90°	97,5°	105°	112,5°	120°	127,5°	135°	142,5°	150°	157,5°	165°	172,5°

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TABLE (25) for the western component Y /36

u	λ = / φ	180° Y	187,5 Y	195° Y	202,5 Y	210° Y	217,5 Y	225° Y	232,5 Y	240° Y	247,5 Y	255° Y	262,5 Y
0	+90	-0,317	-0,288	-0,255	-0,213	-0,176	-0,131	-0,084	-0,036	+0,013	+0,061	+0,109	+0,155
5	+85	-0,331	-0,323	-0,310	-0,290	-0,262	-0,223	-0,176	-0,120	-0,057	+0,013	+0,087	+0,163
10	+80	-0,331	-0,359	-0,365	-0,369	-0,361	-0,336	-0,295	-0,236	-0,163	-0,076	+0,021	+0,125
15	+75	-0,324	-0,377	-0,420	-0,450	-0,463	-0,453	-0,421	-0,365	-0,286	-0,185	-0,064	+0,064
20	+70	-0,324	-0,405	-0,474	-0,527	-0,559	-0,563	-0,539	-0,483	-0,399	-0,289	-0,158	-0,007
25	+65	-0,331	-0,433	-0,523	-0,594	-0,642	-0,658	-0,643	-0,591	-0,508	-0,392	-0,249	-0,083
30	+60	-0,345	-0,462	-0,565	-0,648	-0,706	-0,732	-0,726	-0,684	-0,605	-0,485	-0,335	-0,157
35	+55	-0,367	-0,490	-0,596	-0,681	-0,742	-0,775	-0,777	-0,744	-0,673	-0,559	-0,411	-0,229
40	+50	-0,394	-0,515	-0,617	-0,697	-0,754	-0,790	-0,798	-0,776	-0,718	-0,615	-0,475	-0,295
45	+45	-0,426	-0,536	-0,626	-0,696	-0,746	-0,776	-0,790	-0,780	-0,736	-0,648	-0,521	-0,349
50	+40	-0,458	-0,552	-0,623	-0,678	-0,707	-0,739	-0,758	-0,760	-0,733	-0,665	-0,553	-0,395
55	+35	-0,482	-0,556	-0,605	-0,639	-0,656	-0,683	-0,705	-0,719	-0,710	-0,661	-0,572	-0,433
60	+30	-0,501	-0,552	-0,579	-0,589	-0,595	-0,616	-0,639	-0,664	-0,672	-0,645	-0,579	-0,463
65	+25	-0,512	-0,541	-0,547	-0,539	-0,531	-0,546	-0,569	-0,601	-0,625	-0,616	-0,574	-0,482
70	+20	-0,519	-0,528	-0,514	-0,491	-0,472	-0,480	-0,502	-0,539	-0,574	-0,582	-0,561	-0,494
75	+15	-0,521	-0,517	-0,487	-0,453	-0,426	-0,427	-0,447	-0,486	-0,527	-0,548	-0,545	-0,501
80	+10	-0,523	-0,506	-0,468	-0,426	-0,393	-0,389	-0,405	-0,444	-0,487	-0,518	-0,529	-0,507
85	+5	-0,527	-0,504	-0,462	-0,415	-0,378	-0,370	-0,382	-0,417	-0,460	-0,497	-0,520	-0,516
90	0	-0,536	-0,510	-0,466	-0,418	-0,378	-0,366	-0,373	-0,404	-0,444	-0,485	-0,517	-0,530
95	-5	-0,551	-0,525	-0,482	-0,435	-0,395	-0,378	-0,378	-0,403	-0,439	-0,483	-0,523	-0,551
100	-10	-0,573	-0,547	-0,506	-0,462	-0,422	-0,400	-0,395	-0,414	-0,447	-0,493	-0,540	-0,581
105	-15	-0,602	-0,577	-0,538	-0,494	-0,453	-0,429	-0,423	-0,439	-0,471	-0,522	-0,575	-0,625
110	-20	-0,633	-0,610	-0,571	-0,527	-0,486	-0,462	-0,455	-0,471	-0,506	-0,562	-0,622	-0,679
115	-25	-0,663	-0,640	-0,601	-0,557	-0,516	-0,492	-0,486	-0,505	-0,546	-0,609	-0,677	-0,742
120	-30	-0,687	-0,664	-0,626	-0,583	-0,544	-0,521	-0,518	-0,544	-0,592	-0,663	-0,739	-0,810
125	-35	-0,702	-0,680	-0,644	-0,603	-0,568	-0,550	-0,553	-0,588	-0,644	-0,724	-0,807	-0,882
130	-40	-0,704	-0,686	-0,653	-0,617	-0,588	-0,579	-0,591	-0,635	-0,701	-0,788	-0,877	-0,951
135	-45	-0,687	-0,676	-0,651	-0,623	-0,604	-0,606	-0,629	-0,685	-0,760	-0,853	-0,945	-1,020
140	-50	-0,656	-0,655	-0,642	-0,627	-0,620	-0,635	-0,671	-0,737	-0,820	-0,916	-1,007	-1,080
145	-55	-0,6[illegible]3	-0,627	-0,630	-0,633	-0,642	-0,672	-0,719	-0,792	-0,877	-0,972	-1,059	-1,126
150	-60	-0,561	-0,594	-0,617	-0,640	-0,668	-0,713	-0,771	-0,848	-0,933	-1,023	-1,104	-1,162
155	-65	-0,503	-0,557	-0,604	-0,650	-0,698	-0,759	-0,826	-0,906	-0,991	-1,072	-1,142	-1,187
160	-70	-0,448	-0,525	-0,595	-0,664	-0,733	-0,807	-0,883	-0,964	-1,042	-1,114	-1,171	-1,203
165	-75	-0,407	-0,506	-0,598	-0,687	-0,772	-0,858	-0,938	-1,017	-1,084	-1,145	-1,186	-1,204
170	-80	-0,377	-0,497	-0,610	-0,716	-0,811	-0,909	-0,993	-1,068	-1,127	-1,172	-1,198	-1,204
175	-85	-0,352	-0,492	-0,625	-0,749	-0,862	-0,963	-1,051	-1,123	-1,178	-1,212	-1,230	-1,225
180	-90	-0,333	-0,491	-0,640	-0,778	-0,903	-1,012	-1,105	-1,178	-1,232	-1,264	-1,275	-1,264
	λ =	180°	187,5	195°	202,5	210°	217,5	225°	232,5	240°	247,5	255°	262,5

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TABLE (25) for the western component Y

u.	λ = / φ.	270° Y	277,5° Y	285° Y	292,5° Y	300° Y	307,5° Y	315° Y	322,5° Y	330° Y	337,5° Y	345° Y	352,5° Y
0	+90°	+0,198	+0,238	+0,273	+0,303	+0,329	+0,349	+0,364	+0,372	+0,376	+0,369	+0,357	+0,340
5	+85	+0,239	+0,308	+0,375	+0,433	+0,481	+0,514	+0,534	+0,539	+0,530	+0,507	+0,472	+0,425
10	+80	+0,230	+0,332	+0,427	+0,508	+0,573	+0,621	+0,649	+0,653	+0,637	+0,601	+0,549	+0,481
15	+75	+0,193	+0,326	+0,444	+0,546	+0,630	+0,689	+0,726	+0,731	+0,707	+0,662	+0,599	+0,516
20	+70	+0,145	+0,295	+0,444	+0,565	+0,671	+0,741	+0,781	+0,787	+0,763	+0,712	+0,638	+0,546
25	+65	+0,092	+0,267	+0,436	+0,580	+0,697	+0,777	+0,823	+0,830	+0,805	+0,751	+0,672	+0,576
30	+60	+0,034	+0,228	+0,418	+0,575	+0,705	+0,795	+0,848	+0,859	+0,836	+0,782	+0,703	+0,604
35	+55	-0,029	+0,178	+0,377	+0,550	+0,693	+0,794	+0,856	+0,874	+0,857	+0,808	+0,733	+0,636
40	+50	-0,093	+0,120	+0,327	+0,510	+0,664	+0,776	+0,848	+0,877	+0,870	+0,830	+0,763	+0,672
45	+45	-0,152	+0,060	+0,265	+0,457	+0,618	+0,739	+0,823	+0,867	+0,876	+0,850	+0,795	+0,712
50	+40	-0,209	-0,004	+0,203	+0,392	+0,557	+0,687	+0,784	+0,848	+0,877	+0,869	+0,829	+0,756
55	+35	-0,264	-0,072	+0,127	+0,313	+0,481	+0,622	+0,736	+0,821	+0,873	+0,889	+0,869	+0,808
60	+30	-0,314	-0,139	+0,047	+0,226	+0,396	+0,548	+0,679	+0,787	+0,865	+0,907	+0,907	+0,860
65	+25	-0,356	-0,208	-0,038	+0,138	+0,307	+0,468	+0,616	+0,748	+0,853	+0,919	+0,942	+0,907
70	+20	-0,393	-0,262	-0,111	+0,049	+0,216	+0,385	+0,550	+0,706	+0,838	+0,929	+0,972	+0,957
75	+15	-0,425	-0,319	-0,188	-0,039	+0,125	+0,304	+0,487	+0,666	+0,824	+0,938	+1,000	+0,991
80	+10	-0,455	-0,373	-0,263	-0,125	+0,037	+0,226	+0,425	+0,626	+0,807	+0,942	+1,022	+1,028
85	+5	-0,486	-0,426	-0,334	-0,205	-0,044	+0,153	+0,366	+0,586	+0,785	+0,938	+1,033	+1,047
90	0	-0,520	-0,478	-0,401	-0,279	-0,118	+0,086	+0,311	+0,547	+0,762	+0,928	+1,036	+1,061
95	-5	-0,558	-0,531	-0,465	-0,347	-0,185	+0,028	+0,265	+0,513	+0,740	+0,915	+1,032	+1,070
100	-10	-0,601	-0,586	-0,528	-0,411	-0,245	-0,023	+0,225	+0,481	+0,716	+0,898	+1,022	+1,071
105	-15	-0,653	-0,646	-0,589	-0,471	-0,299	-0,068	+0,189	+0,451	+0,691	+0,876	+1,005	+1,060
110	-20	-0,713	-0,707	-0,652	-0,529	-0,350	-0,111	+0,153	+0,419	+0,662	+0,853	+0,983	+1,042
115	-25	-0,782	-0,777	-0,720	-0,590	-0,404	-0,158	+0,112	+0,382	+0,628	+0,819	+0,956	+1,022
120	-30	-0,854	-0,849	-0,789	-0,652	-0,458	-0,208	+0,066	+0,338	+0,586	+0,780	+0,922	+0,997
125	-35	-0,927	-0,919	-0,855	-0,712	-0,513	-0,262	+0,013	+0,285	+0,534	+0,732	+0,879	+0,964
130	-40	-0,997	-0,986	-0,917	-0,772	-0,571	-0,320	-0,047	+0,223	+0,472	+0,673	+0,827	+0,923
135	-45	-1,063	-1,049	-0,977	-0,833	-0,634	-0,387	-0,119	+0,147	+0,395	+0,600	+0,763	+0,873
140	-50	-1,119	-1,102	-1,029	-0,888	-0,696	-0,457	-0,197	+0,063	+0,308	+0,516	+0,688	+0,812
145	-55	-1,159	-1,135	-1,067	-0,931	-0,748	-0,523	-0,278	-0,029	+0,210	+0,419	+0,597	+0,735
150	-60	-1,186	-1,163	-1,092	-0,964	-0,793	-0,585	-0,357	-0,122	+0,108	+0,316	+0,495	+0,648
155	-65	-1,202	-1,174	-1,104	-0,986	-0,829	-0,639	-0,429	-0,211	+0,006	+0,210	[illegible]	+0,555
160	-70	-1,207	-1,174	-1,105	-0,996	-0,854	-0,682	-0,491	-0,290	-0,087	+0,111	+0,287	+0,463
165	-75	-1,197	-1,160	-1,090	-0,991	-0,861	-0,708	-0,535	-0,349	-0,160	+0,029	+0,212	+0,381
170	-80	-1,184	-1,142	-1,072	-0,977	-0,859	-0,719	-0,563	-0,395	-0,220	-0,041	+0,136	+0,306
175	-85	-1,196	-1,147	-1,077	-0,984	-0,872	-0,742	-0,597	-0,441	-0,276	-0,105	+0,067	+0,236
180	-90	-1,231	-1,177	-1,103	-1,010	-0,900	-0,774	-0,635	-0,485	-0,347	-0,164	+0,002	+0,169
	λ =	270°	277,5	285°	292,5	300°	307,5	315°	322,5	330°	337,5	345°	352,5

TABLE (26) for the vertical component Z /38

u	λ = / φ	0° Z	7,5 Z	15° Z	22,5 Z	30° Z	37,5 Z	45° Z	52,5 Z	60° Z	67,5 Z	75° Z	82,5 Z
0°	+90°	+5,550	+5,550	+5,550	+5,550	+5,550	+5,550	+5,550	+5,550	+5,550	+5,550	+5,550	+5,550
5	+85	+5,522	+5,520	+5,521	+5,526	+5,534	+5,545	+5,558	+5,575	+5,595	+5,516	+5,533	+5,553
10	+80	+5,258	+5,253	+5,257	+5,271	+5,292	+5,320	+5,356	+5,394	+5,438	+5,482	+5,528	+5,571
15	+75	+5,026	+5,015	+5,020	+5,106	+5,138	+5,183	+5,261	+5,309	+5,382	+5,454	+5,524	+5,592
20	+70	+4,923	+4,910	+4,918	+4,947	+4,994	+5,057	+5,134	+5,223	+5,318	+5,416	+5,512	+5,602
25	+65	+4,775	+4,757	+4,765	+4,798	+4,852	+4,926	+5,017	+5,123	+5,237	+5,355	+5,471	+5,579
30	+60	+4,624	+4,599	+4,604	+4,637	+4,695	+4,775	+4,874	+4,990	+5,116	+5,248	+5,379	+5,501
35	+55	+4,463	+4,428	+4,425	+4,453	+4,509	+4,588	+4,688	+4,805	+4,935	+5,073	+5,210	+5,338
40	+50	+4,270	+4,220	+4,205	+4,224	+4,273	+4,347	+4,442	+4,557	+4,682	+4,819	+4,956	+5,087
45	+45	+4,022	+3,952	+3,920	+3,926	+3,963	+4,028	+4,114	+4,218	+4,337	+4,467	+4,598	+4,721
50	+40	+3,715	+3,620	+3,565	+3,554	+3,578	+3,636	+3,706	+3,799	+3,906	+4,025	+4,148	+4,276
55	+35	+3,331	+3,203	+3,120	+3,090	+3,099	+3,140	+3,207	+3,289	+3,383	+3,491	+3,604	+3,723
60	+30	+2,885	+2,721	+2,607	+2,556	+2,549	+2,579	+2,636	+2,705	+2,787	+2,882	+2,984	+3,095
65	+25	+2,376	+2,177	+2,032	+1,956	+1,935	+1,952	+1,998	+2,055	+2,125	+2,206	+2,297	+2,463
70	+20	+1,831	+1,598	+1,423	+1,322	+1,283	+1,286	+1,319	+1,362	+1,420	+1,487	+1,568	+1,669
75	+15	+1,267	+1,003	+0,799	+0,676	+0,615	+0,601	+0,618	+0,646	+0,690	+0,746	+0,819	+0,916
80	+10	+0,705	+0,414	+0,185	+0,040	-0,044	-0,079	-0,080	-0,065	-0,040	+0,005	+0,069	+0,161
85	+5	+0,167	-0,143	-0,393	-0,560	-0,668	-0,726	-0,750	-0,757	-0,744	-0,713	-0,660	-0,577
90	0	-0,332	-0,660	-0,926	-1,114	-1,245	-1,328	-1,376	-1,404	-1,409	-1,394	-1,355	-1,287
95	-5	-0,791	-1,118	-1,394	-1,600	-1,753	-1,861	-1,935	-1,988	-2,015	-2,020	-2,000	-1,954
100	-10	-1,193	-1,518	-1,800	-2,020	-2,193	-2,326	-2,426	-2,504	-2,557	-2,584	-2,588	-2,570
105	-15	-1,532	-1,852	-2,135	-2,366	-2,557	-2,712	-2,837	-2,940	-3,019	-3,072	-3,105	-3,121
110	-20	-1,821	-2,131	-2,411	-2,649	-2,854	-3,028	-3,176	-3,302	-3,407	-3,488	-3,553	-3,608
115	-25	-2,061	-2,360	-2,634	-2,874	-3,087	-3,276	-3,460	-3,587	-3,716	-3,828	-3,929	-4,024
120	-30	-2,271	-2,555	-2,820	-3,057	-3,271	-3,469	-3,648	-3,812	-3,963	-4,104	-4,239	-4,374
125	-35	-2,461	-2,728	-2,980	-3,211	-3,426	-3,625	-3,811	-3,986	-4,154	-4,319	-4,483	-4,653
130	-40	-2,653	-2,897	-3,133	-3,354	-3,563	-3,760	-3,948	-4,130	-4,311	-4,494	-4,681	-4,880
135	-45	-2,866	-3,081	-3,294	-3,499	-3,697	-3,888	-4,075	-4,261	-4,451	-4,647	-4,850	-5,067
140	-50	-3,114	-3,296	-3,483	-3,667	-3,850	-4,030	-4,212	-4,398	-4,590	-4,793	-5,004	-5,227
145	-55	-3,419	-3,568	-3,725	-3,885	-4,049	-4,215	-4,386	-4,564	-4,751	-4,950	-5,158	-5,376
150	-60	-3,780	-3,892	-4,018	-4,152	-4,294	-4,441	-4,597	-4,762	-4,937	-5,124	-5,319	-5,522
155	-65	-4,202	-4,281	-4,375	-4,480	-4,597	-4,723	-4,859	-5,006	-5,162	-5,328	-5,501	-5,681
160	-70	-4,663	-4,711	-4,775	-4,852	-4,942	-5,044	-5,157	-5,280	-5,412	-5,551	-5,696	-5,846
165	-75	-5,145	-5,173	-5,210	-5,260	-5,326	-5,397	-5,481	-5,576	-5,682	-5,786	-5,901	-6,016
170	-80	-5,626	-5,635	-5,655	-5,684	-5,723	-5,768	-5,825	-5,888	-5,957	-6,030	-6,107	-6,187
175	-85	-6,044	-6,045	-6,052	-6,065	-6,085	-6,105	-6,132	-6,163	-6,197	-6,235	-6,274	-6,314
180	-90	-6,382	-6,382	-6,382	-6,382	-6,382	-6,382	-6,382	-6,382	-6,382	-6,382	-6,382	-6,382
	λ	0°	7,5	15°	22,5	30°	37,5	45°	52,5	60°	67,5	75°	82,5

TABLE (26) for the vertical component Z

u	φ	λ = 90° z	97,5 z	105° z	112,5 z	120° z	127,5 z	135° z	142,5 z	150° z	157,5 z	165° z	172,5 z
0°	+90	+5,550	+5,550	+5,550	+5,550	+5,550	+5,550	+5,550	+5,550	+5,550	+5,550	+5,550	+5,550
5	+85	+5,573	+5,592	+5,609	+5,625	+5,640	+5,653	+5,664	+5,674	+5,682	+5,688	+5,693	+5,690
10	+80	+5,619	+5,648	+5,680	+5,705	+5,726	+5,739	+5,750	+5,757	+5,761	+5,763	+5,765	+5,768
15	+75	+5,653	+5,707	+5,745	+5,772	+5,778	+5,795	+5,793	+5,785	+5,776	+5,764	+5,756	+5,752
20	+70	+5,681	+5,743	+5,788	+5,814	+5,816	+5,803	+5,778	+5,744	+5,708	+5,674	+5,648	+5,636
25	+65	+5,673	+5,743	+5,788	+5,802	+5,789	+5,750	+5,695	+5,627	+5,558	+5,497	+5,451	+5,429
30	+60	+5,605	+5,680	+5,723	+5,724	+5,690	+5,622	+5,532	+5,428	+5,325	+5,238	+5,174	+5,145
35	+55	+5,448	+5,523	+5,560	+5,547	+5,492	+5,394	+5,270	+5,133	+5,001	+4,896	+4,821	+4,795
40	+50	+5,138	+5,271	+5,304	+5,278	+5,204	+5,079	+4,926	+4,762	+4,603	+4,491	+4,417	+4,401
45	+45	+4,835	+4,913	+4,963	+4,910	+4,822	+4,678	+4,507	+4,327	+4,165	+4,048	+3,983	+3,986
50	+40	+4,383	+4,458	+4,488	+4,455	+4,360	+4,207	+4,028	+3,845	+3,684	+3,580	+3,531	+3,561
55	+35	+3,829	+3,906	+3,941	+3,912	+3,825	+3,677	+3,505	+3,333	+3,188	+3,108	+3,089	+3,148
60	+30	+3,198	+3,280	+3,324	+3,305	+3,225	+3,103	+2,948	+2,798	+2,679	+2,630	+2,643	+2,738
65	+25	+2,506	+2,597	+2,655	+2,654	+2,607	+2,501	+2,375	+2,256	+2,169	+2,155	+2,199	+2,313
70	+20	+1,774	+1,874	+1,948	+1,968	+1,946	+1,872	+1,781	+1,697	+1,645	+1,665	+1,739	+1,873
75	+15	+1,023	+1,130	+1,218	+1,259	+1,264	+1,221	+1,167	+1,119	+1,101	+1,150	+1,247	+1,394
80	+10	+0,266	+0,376	+0,473	+0,532	+0,568	+0,546	+0,526	+0,512	+0,526	+0,600	+0,715	+0,870
85	+5	−0,479	−0,374	−0,276	−0,208	−0,167	−0,137	−0,153	−0,138	−0,094	−0,003	+0,124	+0,283
90	0	−1,203	−1,110	−1,021	−0,954	−0,909	−0,885	−0,862	−0,823	−0,759	−0,649	−0,512	−0,350
95	−5	−1,892	−1,822	−1,764	−1,702	−1,664	−1,637	−1,603	−1,548	−1,465	−1,341	−1,193	−1,025
100	−10	−2,538	−2,500	−2,462	−2,436	−2,413	−2,391	−2,354	−2,288	−2,189	−2,052	−1,892	−1,716
105	−15	−3,127	−3,131	−3,133	−3,142	−3,145	−3,136	−3,101	−3,029	−2,918	−2,767	−2,592	−2,428
110	−20	−3,656	−3,706	−3,753	−3,801	−3,835	−3,843	−3,816	−3,740	−3,622	−3,458	−3,269	−3,069
115	−25	−4,117	−4,214	−4,307	−4,394	−4,459	−4,486	−4,470	−4,394	−4,270	−4,096	−3,895	−3,681
120	−30	−4,510	−4,652	−4,787	−4,911	−5,005	−5,052	−5,048	−4,976	−4,851	−4,673	−4,464	−4,251
125	−35	−4,827	−5,006	−5,177	−5,332	−5,452	−5,517	−5,525	−5,461	−5,341	−5,166	−4,960	−4,746
130	−40	−5,083	−5,291	−5,489	−5,667	−5,807	−5,887	−5,908	−5,856	−5,747	−5,585	−5,391	−5,185
135	−45	−5,287	−5,511	−5,723	−5,912	−6,062	−6,153	−6,188	−6,153	−6,064	−5,925	−5,756	−5,578
140	−50	−5,454	−5,683	−5,898	−6,087	−6,240	−6,340	−6,388	−6,374	−6,310	−6,201	−6,065	−5,919
145	−55	−5,597	−5,818	−6,025	−6,207	−6,357	−6,463	−6,523	−6,532	−6,499	−6,427	−6,333	−6,227
150	−60	−5,727	−5,930	−6,121	−6,290	−6,433	−6,540	−6,611	−6,641	−6,638	−6,605	−6,552	−6,487
155	−65	−5,862	−6,040	−6,209	−6,360	−6,491	−6,596	−6,676	−6,723	−6,745	−6,744	−6,727	−6,697
160	−70	−5,997	−6,145	−6,286	−6,415	−6,530	−6,627	−6,709	−6,767	−6,806	−6,829	−6,839	−6,836
165	−75	−6,135	−6,247	−6,359	−6,460	−6,552	−6,637	−6,708	−6,767	−6,811	−6,848	−6,869	−6,888
170	−80	−6,268	−6,347	−6,425	−6,497	−6,565	−6,627	−6,683	−6,731	−6,771	−6,803	−6,827	−6,848
175	−85	−6,355	−6,397	−6,436	−6,474	−6,511	−6,545	−6,576	−6,604	−6,629	−6,649	−6,664	−6,675
180	−90	−6,382	−6,382	−6,382	−6,382	−6,382	−6,382	−6,382	−6,382	−6,382	−6,382	−6,382	−6,382
	λ =	90°	97,5	105°	112,5	120°	127,5	135°	142,5	150°	157,5	165°	172,5

TABLE (26) for the vertical component Z

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	λ =	180°	187,5°	195°	202,5°	210°	217,5°	225°	232,5°	240°	247,5°	255°	262,5°
u	φ	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
0	+90	+5,550	+5,550	+5,550	+5,550	+5,550	+5,550	+5,550	+5,550	+5,550	+5,550	+5,550	+5,550
5	+85	+5,702	+5,705	+5,707	+5,707	+5,706	+5,705	+5,702	+5,696	+5,686	+5,675	+5,663	+5,649
10	+80	+5,772	+5,778	+5,785	+5,793	+5,802	+5,811	+5,819	+5,817	+5,816	+5,808	+5,796	+5,778
15	+75	+5,756	+5,766	+5,784	+5,807	+5,835	+5,864	+5,891	+5,914	+5,931	+5,937	+5,930	+5,909
20	+70	+5,653	+5,656	+5,676	+5,733	+5,798	+5,852	+5,894	+5,923	+6,022	+6,055	+6,060	+6,057
25	+65	+5,430	+5,457	+5,509	+5,583	+5,673	+5,776	+5,881	+5,983	+6,072	+6,141	+6,183	+6,190
30	+60	+5,150	+5,192	+5,266	+5,368	+5,498	+5,636	+5,786	+5,932	+6,046	+6,124	+6,157	+6,152
35	+55	+4,811	+4,873	+4,972	+5,101	+5,257	+5,433	+5,618	+5,803	+5,976	+6,117	+6,192	+6,203
40	+50	+4,434	+4,518	+4,641	+4,795	+4,973	+5,171	+5,380	+5,596	+5,806	+5,991	+6,142	+6,236
45	+45	+4,042	+4,148	+4,290	+4,458	+4,647	+4,853	+5,071	+5,304	+5,532	+5,747	+5,927	+6,057
50	+40	+3,693	+3,768	+3,925	+4,096	+4,284	+4,484	+4,692	+4,938	+5,168	+5,400	+5,602	+5,758
55	+35	+3,357	+3,399	+3,562	+3,724	+3,894	+4,071	+4,263	+4,480	+4,707	+4,941	+5,155	+5,324
60	+30	+2,865	+3,020	+3,183	+3,321	+3,471	+3,641	+3,774	+3,963	+4,169	+4,395	+4,618	+4,791
65	+25	+2,463	+2,621	+2,776	+2,901	+3,013	+3,110	+3,218	+3,351	+3,568	+3,774	+3,970	+4,164
70	+20	+2,033	+2,190	+2,333	+2,435	+2,517	+2,586	+2,664	+2,779	+2,922	+3,102	+3,292	+3,492
75	+15	+1,558	+1,710	+1,835	+1,919	+1,975	+2,013	+2,058	+2,133	+2,248	+2,359	+2,568	+2,738
80	+10	+1,035	+1,130	+1,237	+1,340	+1,396	+1,411	+1,434	+1,585	+1,514	+1,687	+1,833	+1,992
85	+5	+0,644	+0,585	+0,691	+0,734	+0,724	+0,793	+0,802	+0,835	+0,893	+0,992	+1,117	+1,265
90	0	-0,188	-0,051	+0,052	+0,120	+0,153	+0,169	+0,179	+0,196	+0,241	+0,323	+0,431	+0,570
95	-5°	-0,859	-0,717	-0,602	-0,530	-0,485	-0,461	-0,444	-0,419	-0,376	-0,304	-0,203	-0,067
100	-10	-1,593	-1,392	-1,266	-1,179	-1,117	-1,076	-1,044	-1,011	-0,965	-0,894	-0,794	-0,654
105	-15	-2,220	-2,055	-1,913	-1,808	-1,727	-1,668	-1,621	-1,577	-1,522	-1,445	-1,337	-1,183
110	-20	-2,871	-2,692	-2,535	-2,412	-2,314	-2,240	-2,179	-2,123	-2,057	-1,967	-1,845	-1,672
115	-25	-3,470	-3,295	-3,119	-2,995	-2,878	-2,789	-2,720	-2,653	-2,575	-2,469	-2,327	-2,131
120	-30	-4,023	-3,816	-3,654	-3,577	-3,407	-3,332	-3,246	-3,171	-3,081	-2,958	-2,795	-2,576
125	-35	-4,524	-4,331	-4,163	-4,038	-3,921	-3,838	-3,762	-3,683	-3,585	-3,447	-3,265	-3,045
130	-40	-4,981	-4,800	-4,643	-4,520	-4,421	-4,342	-4,262	-4,187	-4,081	-3,931	-3,735	-3,479
135	-45	-5,397	-5,239	-5,102	-4,996	-4,911	-4,846	-4,770	-4,681	-4,575	-4,417	-4,212	-3,950
140	-50	-5,774	-5,645	-5,533	-5,447	-5,376	-5,315	-5,248	-5,163	-5,043	-4,886	-4,680	-4,420
145	-55	-6,120	-6,024	-5,939	-5,873	-5,814	-5,758	-5,693	-5,607	-5,491	-5,330	-5,130	-4,883
150	-60	-6,418	-6,355	-6,296	-6,247	-6,198	-6,147	-6,083	-5,997	-5,883	-5,720	-5,543	-5,318
155	-65	-6,660	-6,634	-6,585	-6,549	-6,508	-6,460	-6,398	-6,314	-6,206	-6,068	-5,902	-5,706
160	-70	-6,835	-6,809	-6,787	-6,761	-6,726	-6,682	-6,623	-6,545	-6,448	-6,329	-6,190	-6,028
165	-75	-6,935	-6,914	-6,891	-6,852	-6,825	-6,787	-6,733	-6,664	-6,576	-6,472	-6,354	-6,228
170	-80	-6,952	-6,953	-6,947	-6,933	-6,911	-6,880	-6,839	-6,788	-6,723	-6,642	-6,547	-6,445
175	-85	-6,882	-6,934	-6,970	-6,971	-6,957	-6,935	-6,906	-6,867	-6,815	-6,750	-6,682	-6,611
180	-90	-6,832	-6,832	-6,832	-6,832	-6,832	-6,832	-6,832	-6,832	-6,832	-6,832	-6,832	-6,832
	λ =	180°	187,5°	195°	202,5°	210°	217,5°	225°	232,5°	240°	247,5°	255°	262,5°

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TABLE (26) for the vertical component Z /41

λ =	270°	277,5°	285°	292,5°	300°	307,5°	315°	322,5°	330°	337,5°	345°	352,5°
θ φ	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
0 +90	+5,550	+5,550	+5,550	+5,550	+5,550	+5,550	+5,550	+5,550	+5,550	+5,550	+5,550	+5,550
5 +85	+5,631	+5,612	+5,591	+5,570	+5,548	+5,526	+5,504	+5,484	+5,466	+5,451	+5,439	+5,429
10 +80	+5,742	+5,705	+5,662	+5,615	+5,566	+5,514	+5,462	+5,413	+5,368	+5,329	+5,297	+5,273
15 +75	+5,834	+5,822	+5,752	+5,685	+5,603	+5,516	+5,428	+5,343	+5,266	+5,198	+5,145	+5,105
20 +70	+6,023	+5,962	+5,880	+5,779	+5,664	+5,540	+5,414	+5,294	+5,184	+5,089	+5,012	+4,957
25 +65	+6,163	+6,098	+6,001	+5,875	+5,729	+5,569	+5,407	+5,252	+5,111	+4,989	+4,890	+4,819
30 +60	+6,249	+6,205	+6,099	+5,952	+5,774	+5,587	+5,392	+5,206	+5,035	+4,888	+4,768	+4,681
35 +55	+6,312	+6,256	+6,148	+5,982	+5,793	+5,577	+5,354	+5,142	+4,945	+4,777	+4,637	+4,534
40 +50	+6,270	+6,229	+6,126	+5,961	+5,754	+5,522	+5,280	+5,047	+4,829	+4,640	+4,481	+4,358
45 +45	+6,112	+6,091	+6,002	+5,844	+5,629	+5,403	+5,152	+4,906	+4,671	+4,462	+4,280	+4,133
50 +40	+5,839	+5,842	+5,774	+5,634	+5,445	+5,213	+4,964	+4,712	+4,466	+4,236	+4,029	+3,854
55 +35	+5,434	+5,466	+5,426	+5,312	+5,145	+4,937	+4,701	+4,453	+4,200	+3,951	+3,716	+3,507
60 +30	+4,924	+4,982	+4,974	+4,894	+4,761	+4,583	+4,370	+4,132	+3,877	+3,618	+3,367	+3,100
65 +25	+4,310	+4,394	+4,419	+4,379	+4,286	+4,147	+3,965	+3,743	+3,490	+3,206	+2,915	+2,631
70 +20	+3,686	+3,733	+3,752	+3,795	+3,748	+3,652	+3,506	+3,304	+3,055	+2,758	+2,441	+2,133
75 +15	+2,996	+3,023	+3,115	+3,163	+3,163	+3,112	+3,003	+2,823	+2,584	+2,277	+1,940	+1,593
80 +10	+2,150	+2,295	+2,418	+2,505	+2,556	+2,549	+2,476	+2,319	+2,096	+1,779	+1,427	+1,057
85 +5	+1,423	+1,583	+1,732	+1,861	+1,950	+1,981	+1,942	+1,865	+1,537	+1,276	+0,917	+0,535
90 0	+0,729	+0,904	+1,077	+1,239	+1,365	+1,430	+1,418	+1,292	+1,091	+0,735	+0,425	+0,038
95 −5	+0,096	+0,287	+0,484	+0,675	+0,830	+0,922	+0,929	+0,823	+0,623	+0,324	−0,033	−0,415
100 −10	−0,482	−0,272	−0,055	+0,164	+0,343	+0,455	+0,476	+0,380	+0,187	−0,103	−0,450	−0,823
105 −15	−0,993	−0,761	−0,517	−0,279	−0,084	+0,043	+0,075	−0,015	−0,200	−0,480	−0,815	−1,174
110 −20	−1,460	−1,204	−0,937	−0,679	−0,465	−0,333	−0,292	−0,374	−0,550	−0,817	−1,137	−1,479
115 −25	−1,895	−1,614	−1,325	−1,042	−0,818	−0,676	−0,626	−0,697	−0,861	−1,111	−1,414	−1,736
120 −30	−2,316	−2,013	−1,703	−1,410	−1,167	−1,014	−0,954	−1,010	−1,157	−1,386	−1,666	−1,966
125 −35	−2,744	−2,422	−2,097	−1,791	−1,537	−1,372	−1,297	−1,333	−1,456	−1,656	−1,906	−2,179
130 −40	−3,183	−2,850	−2,515	−2,203	−1,941	−1,764	−1,672	−1,684	−1,777	−1,943	−2,157	−2,399
135 −45	−3,650	−3,317	−2,932	−2,670	−2,404	−2,216	−2,105	−2,081	−2,147	−2,273	−2,447	−2,648
140 −50	−4,126	−3,803	−3,478	−3,174	−2,910	−2,715	−2,588	−2,542	−2,564	−2,645	−2,779	−2,937
145 −55	−4,606	−4,305	−4,002	−3,717	−3,465	−3,265	−3,130	−3,058	−3,044	−3,083	−3,170	−3,284
150 −60	−5,067	−4,797	−4,525	−4,267	−4,035	−3,846	−3,701	−3,610	−3,566	−3,564	−3,610	−3,683
155 −65	−5,489	−5,258	−5,027	−4,804	−4,601	−4,428	−4,287	−4,183	−4,125	−4,100	−4,107	−4,148
160 −70	−5,851	−5,666	−5,480	−5,299	−5,130	−4,921	−4,855	−4,757	−4,686	−4,644	−4,627	−4,634
165 −75	−6,124	−5,987	−5,845	−5,709	−5,582	−5,467	−5,364	−5,281	−5,224	−5,169	−5,145	−5,136
170 −80	−6,318	−6,228	−6,137	−6,049	−5,965	−5,887	−5,817	−5,757	−5,707	−5,669	−5,643	−5,629
175 −85	−6,397	−6,355	−6,312	−6,270	−6,229	−6,191	−6,156	−6,125	−6,099	−6,077	−6,060	−6,049
180 −90	−6,382	−6,382	−6,382	−6,382	−6,382	−6,382	−6,382	−6,382	−6,382	−6,382	−6,382	−6,382

If when interpolating X, Y or Z, from the above Tables (24), (25) and (26), we consider only the first difference, then in individual cases the error of X, Y, Z thus found can rise to at most ±0.01; however, in most cases, it will hardly amount to ±0.005 Gaussian units.

TABLE (27) for the magnetic declination, δ /42

For u = 0° or the astronomical North Pole δ = 58°1'- λ

For u = 180° or the astronomical South Pole δ = λ + 18°9'.

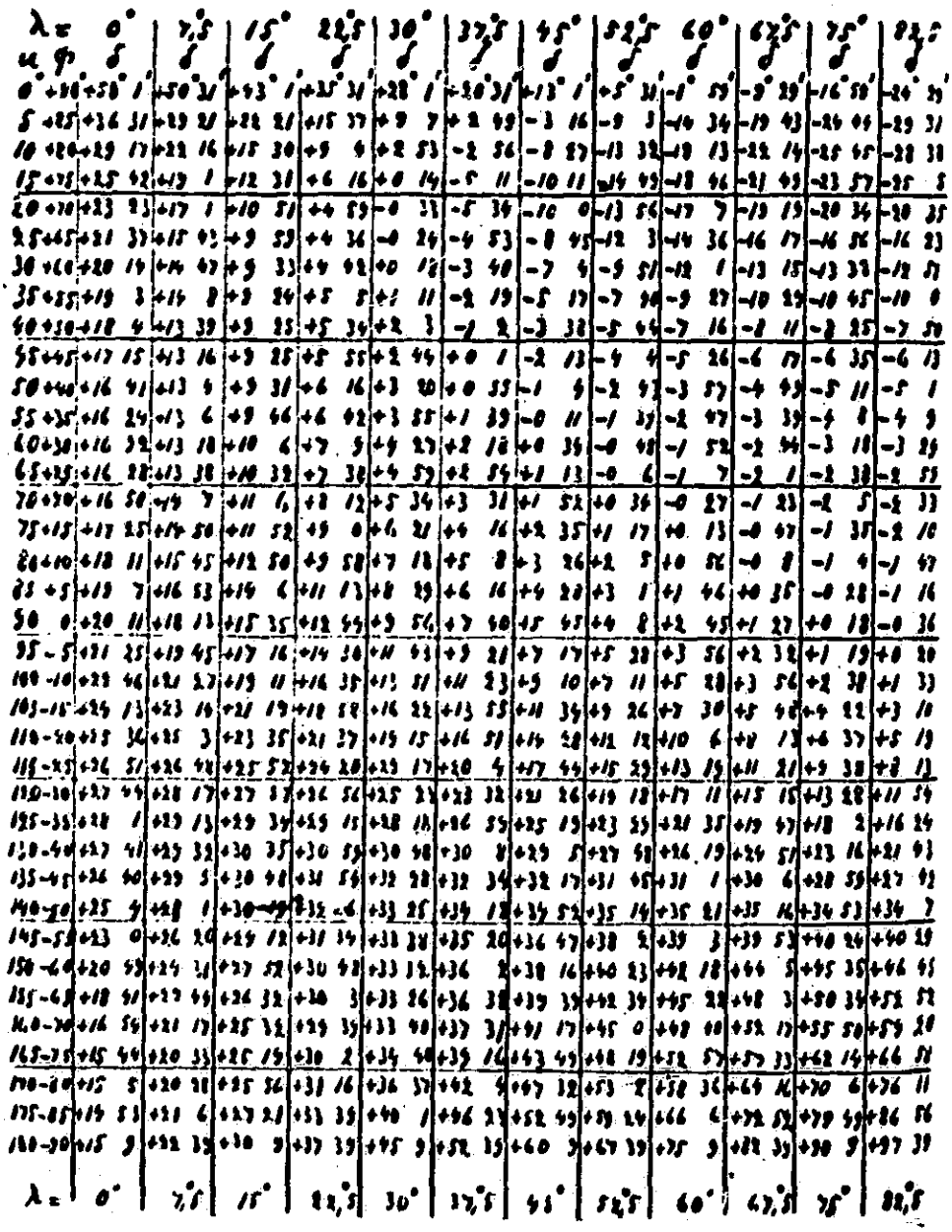

TABLE (27) for the magnetic declination, δ

λ = / u φ	90° δ	97.5° δ	105° δ	112.5° δ	120° δ	127.5° δ	135° δ	142.5° δ	150° δ	157.5° δ	165° δ	172.5° δ
0° +90°	-31°59'	-39°29'	-46°59'	-54°29'	-61°59'	-69°29'	-76°59'	-84°29'	-91°59'	-99°29'	-106°59'	-114°29'
5 +85	-34 1	-38 3	-41 52	-45 34	-49 10	-52 39	-56 11	-60 6	-64 16	-69 2	-75 15	-80 40
10 +80	-30 42	-31 53	-32 20	-32 3	-31 10	-30 37	-30 4	-30 16	-31 14	-33 23	-36 25	-40 30
15 +75	-25 12	-23 57	-21 44	-18 30	-15 23	-12 31	-10 37	-10 21	-11 30	-13 ?3	-16 42	-20 47
20 +70	-19 26	-16 44	-13 8	-8 51	-4 52	-2 16	-0 55	-1 7	-2 31	-5 3	-8 35	-12 43
25 +65	-14 34	-11 27	-7 36	-3 41	+0 24	+2 39	+3 38	+3 7	+1 26	-1 24	-4 35	-9 1
30 +60	-10 57	-7 56	-4 16	-0 24	+2 53	+4 52	+5 18	+4 59	+3 10	+0 18	-3 15	-7 15
35 +55	-8 21	-5 37	-2 27	+0 55	+3 49	+5 37	+6 16	+5 33	+3 44	+0 57	-2 41	-6 39
40 +50	-6 29	-4 12	-1 27	+1 28	+4 0	+5 17	+6 12	+5 25	+3 36	+0 46	-2 45	-6 29
45 +45	-5 10	-3 17	-0 56	+1 37	+3 51	+5 15	+5 42	+4 59	+2 57	+0 6	-3 19	-6 18
50 +40	-4 14	-2 43	-0 46	+1 27	+3 24	+4 37	+4 57	+3 58	+2 2	-0 47	-4 5	-7 23
55 +35	-3 39	-2 27	-0 52	+1 1	+2 [illegible]	+3 44	+3 58	+2 56	+1 1	-1 46	-4 55	-7 52
60 +30	-3 14	-2 20	-1 5	+0 29	+1 [illegible]	+2 48	+2 55	+1 51	-0 3	-2 45	-5 41	-8 8
65 +25	-2 56	-2 19	-1 21	-0 3	+1 9	+1 51	+1 51	+0 45	-1 7	-3 37	-6 18	-8 30
70 +20	-2 42	-2 19	-1 36	-0 33	+0 25	+0 55	+0 48	-0 17	-2 6	-4 25	-6 47	-8 35
75 +15	-2 29	-2 15	-1 48	-1 0	-0 16	+0 2	-0 14	-1 20	-3 1	-5 5	-7 7	-8 33
80 +10	-2 13	-2 11	-1 54	-1 19	-0 48	-0 43	-1 7	-2 14	-3 46	-5 38	-7 22	-8 28
85 +5	-1 49	-1 56	-1 48	-1 27	-1 9	-1 14	-1 45	-2 53	-4 21	-6 1	-7 31	-8 24
90 0	-1 15	-1 25	-1 32	-1 23	-1 19	-1 36	-2 14	-3 26	-4 52	-6 22	-7 40	-8 24
95 -5	-0 24	-0 46	-0 58	-1 3	-1 16	-1 48	-2 39	-3 55	-5 22	-6 47	-7 59	-8 35
100 -10	+0 44	+0 15	-0 8	-0 30	-1 1	-1 51	-2 57	-4 23	-5 54	-7 18	-8 24	-9 1
105 -15	+2 15	+1 36	+1 2	+0 21	-0 30	-1 42	-3 8	-4 49	-6 30	-7 59	-9 8	-9 42
110 -20	+4 15	+3 24	+2 32	+1 30	+0 15	-1 24	-3 14	-5 15	-7 11	-8 49	-10 2	-10 38
115 -25	+6 57	+5 48	+4 34	+3 3	+1 16	-0 57	-3 19	-5 45	-8 2	-9 51	-11 10	-11 47
120 -30	+10 25	+8 55	+7 12	+5 6	+2 37	-0 18	-3 20	-6 20	-9 0	-11 3	-12 32	-13 10
125 -35	+14 43	+12 49	+10 35	+7 45	+4 28	+0 41	-3 13	-6 54	-10 8	-12 31	-14 4	-14 40
130 -40	+19 55	+17 41	+14 55	+11 18	+7 3	+2 9	-2 49	-7 29	-11 20	-14 4	-15 42	-16 15
135 -45	+25 57	+23 34	+20 22	+15 58	+10 38	+4 23	-1 59	-7 42	-12 19	-15 26	-17 13	-17 43
140 -50	+32 47	+30 36	+27 16	+22 18	+15 49	+7 56	-0 13	-7 27	-13 5	-16 43	-18 44	-19 16
145 -55	+39 54	+38 24	+35 30	+30 34	+23 20	+13 45	+3 16	-6 11	-13 20	-17 48	-20 15	-20 59
150 -60	+47 19	+46 55	+45 11	+41 15	+34 19	+23 30	+10 5	-2 56	-12 55	-18 57	-22 13	-23 36
155 -65	+56 43	+55 51	+56 1	+54 25	+49 57	+40 26	+24 52	+5 38	-10 40	-20 28	-25 38	-27 57
160 -70	+62 37	+65 37	+68 10	+69 55	+70 12	+67 33	+58 40	+35 26	-2 13	-25 36	-35 31	-39 20
165 -75	+71 46	+76 37	+81 47	+87 2	+92 40	+98 40	+106°9'	+116°28'	+142°7'	-139°36'	-96 39	-83 2
170 -80	+82 29	+89 3	+96 4	+105°43'	+112°12'	+121°33'	+132°30'	+145°21'	+160°35'	+173°32'	-164°23'	-147°4'
175 -85	+94 14	+101°47'	+109°36'	+117°42'	+126°9'	+134°55'	+144°9'	+153°44'	+163°30'	+173°41'	-176°7'	-165°55'
180 -90	+101°9'	+112°39'	+120°9'	+127°39'	+135°9'	+142°39'	+150°9'	+157°39'	+165°9'	+172°39'	-179°51'	-172°21'
λ =	90°	97.5°	105°	112.5°	120°	127.5°	135°	142.5°	150°	157.5°	165°	172.5°

TABLE (27) for the magnetic declination, δ

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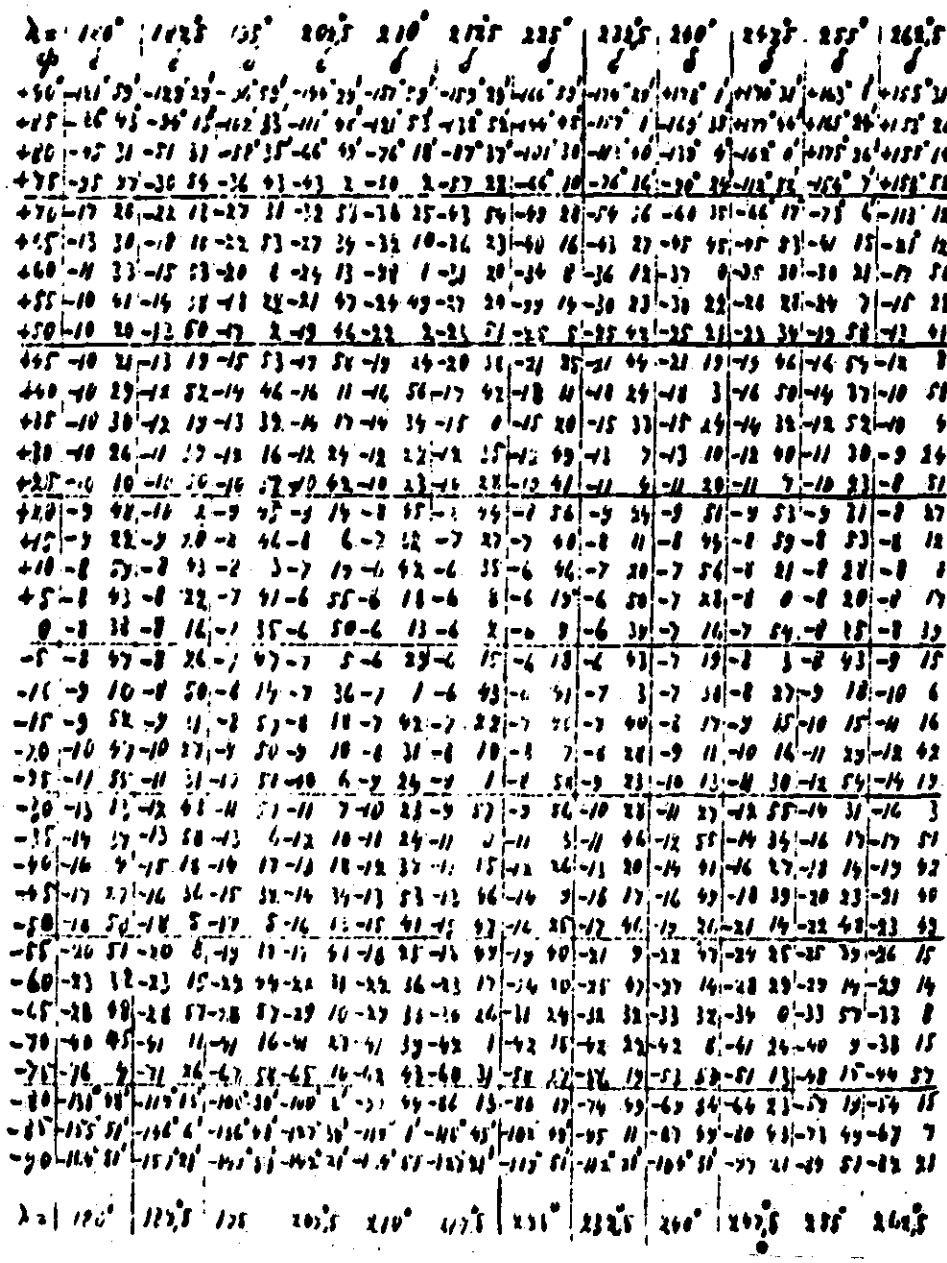

TABLE (27) for the magnetic declination, δ

λ / φ	270°	277.5°	285°	292.5°	300°	307.5°	315°	322.5°	330°	337.5°	345°	352.5°
+90°												
+85°												
+80°												
+75°												
+70°												
+65°												
+60°												
+55°												
+50°												
+45°												
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-35°												
-40°												
-45°												
-50°												
-55°												
-60°												
-65°												
-70°												
-75°												
-80°												
λ / φ	270°	277.5°	285°	292.5°	300°	307.5°	315°	322.5°	330°	337.5°	345°	352.5°

TABLE (28) for the magnetic inclination, i /46

λ → φ ↓	0 i	7°,5 i	15° i	22°,5 i	30° i	37°,5 i	45° i	52°,5 i	60° i	67°,5 i	75° i	82°,5 i
+90	+86° 9'	+86° 9'	+86° 9'	+86° 9'	+86° 9'	+86° 9'	+86° 9'	+86° 9'	+86° 9'	+86° 9'	+86° 9'	+86° 9'
+85	+83 27	+83 24	+83 25	+83 26	+83 30	+83 37	+83 45	+83 55	+84 6	+84 17	+84 30	+84 43
+80	+81 6	+81 4	+81 3	+81 7	+81 13	+81 26	+81 41	+81 59	+82 20	+82 43	+83 8	+83 33
+75	+79 12	+79 5	+79 3	+79 8	+79 16	+79 29	+79 47	+80 11	+80 35	+81 10	+81 42	+82 16
+70	+77 13	+77 4	+77 0	+77 2	+77 9	+77 21	+77 40	+78 6	+78 37	+79 13	+79 52	+80 31
+65	+75 13	+74 56	+74 45	+74 44	+74 48	+74 58	+75 15	+75 51	+76 18	+76 50	+77 31	+78 12
+60	+72 56	+72 30	+72 12	+72 4	+72 4	+72 11	+72 26	+72 49	+73 26	+73 57	+74 37	+75 17
+55	+70 10	+69 33	+69 5	+68 50	+68 44	+68 47	+69 0	+69 20	+69 48	+70 23	+71 2	+71 41
+50	+66 55	+66 3	+65 23	+64 59	+64 47	+64 46	+64 55	+65 13	+65 38	+66 11	+66 47	+67 26
+45	+62 55	+61 56	+60 51	+60 17	+59 58	+59 54	+60 0	+60 16	+60 41	+61 12	+61 47	+62 28
+40	+58 16	+56 44	+55 32	+54 46	+54 20	+54 11	+54 16	+54 31	+54 54	+55 25	+56 1	+56 44
+35	+52 46	+50 45	+49 11	+48 12	+47 39	+47 27	+47 33	+47 48	+48 11	+48 43	+49 21	+50 9
+30	+46 26	+43 52	+41 50	+40 36	+39 56	+39 42	+39 49	+40 3	+40 22	+41 1	+41 42	+42 35
+25	+39 12	+36 1	+33 27	+31 53	+31 4	+30 46	+30 56	+31 10	+31 37	+32 13	+32 59	+33 59
+20	+31 6	+27 12	+24 6	+22 8	+21 8	+20 48	+20 55	+21 11	+21 40	+22 18	+23 8	+24 17
+15	+22 15	+17 37	+13 56	+11 38	+10 24	+9 52	+10 3	+10 18	+10 47	+11 24	+12 13	+13 40
+10	+12 48	+7 30	+3 19	+0 43	-0 46	-1 20	-1 19	-1 7	-0 38	+0 5	+1 4	+2 27
+5	+3 8	-2 40	-7 12	-10 4	-11 45	-12 28	-12 35	-12 25	-11 57	-11 15	-10 14	-8 50
0	-6 30	-12 32	-17 15	-20 19	-22 8	-23 0	-23 13	-23 8	-22 42	-22 0	-21 1	-19 33
-5	-15 32	-21 36	-26 19	-29 25	-31 22	-32 21	-32 43	-32 44	-32 24	-31 46	-30 50	-29 35
-10	-23 46	-29 34	-34 12	-37 19	-39 21	-40 23	-40 59	-41 8	-40 54	-40 21	-39 33	-38 25
-15	-30 35	-36 23	-40 56	-43 52	-46 0	-47 18	-47 58	-48 15	-48 9	-47 43	-47 1	-46 5
-20	-36 59	-42 4	-46 12	-49 15	-51 23	-52 34	-53 46	-54 13	-54 16	-53 58	-53 25	-52 40
-25	-41 55	-46 38	-50 32	-53 31	-55 45	-57 19	-58 21	-58 58	-59 12	-59 6	-58 46	-58 15
-30	-45 56	-50 16	-53 57	-56 30	-59 6	-60 46	-61 57	-62 45	-63 11	-63 17	-63 11	-62 56
-35	-49 3	-53 2	-56 28	-59 16	-61 32	-63 16	-64 35	-65 32	-66 9	-66 29	-66 35	-66 41
-40	-51 38	-55 13	-58 29	-61 4	-63 17	-65 5	-66 29	-67 33	-68 31	-68 55	-69 21	-69 42
-45	-53 47	-56 56	-59 44	-62 19	-64 28	-66 15	-67 43	-68 56	-69 53	-70 41	-71 28	-72 8
-50	-55 48	-58 38	-61 4	-63 32	-65 22	-67 5	-68 34	-69 51	-70 58	-71 58	-72 53	-73 49
-55	-57 56	-60 11	-62 31	-64 23	-66 12	-67 48	-69 15	-70 33	-71 46	-72 54	-74 0	-75 7
-60	-60 16	-62 3	-63 50	-65 53	-67 8	-68 36	-69 57	-71 15	-72 29	-73 41	-74 53	-76 8
-65	-62 54	-64 15	-65 33	-67 1	-68 22	-69 38	-70 53	-72 6	-73 18	-74 31	-75 44	-77 0
-70	-65 46	-66 43	-67 44	-68 56	-69 53	-70 59	-72 4	-73 10	-74 17	-75 25	-76 36	-77 49
-75	-69 0	-69 36	-70 17	-71 4	-71 54	-72 45	-73 38	-74 33	-75 30	-76 30	-77 32	-78 34
-80	-72 10	-72 40	-73 5	-73 35	-74 0	-74 45	-75 25	-76 6	-76 50	-77 35	-78 23	-79 11
-85	-75 35	-75 42	-75 53	-76 9	-76 24	-76 45	-77 7	-77 31	-77 55	-78 22	-78 49	-79 16
-90	-78 42	-78 42	-78 42	-78 42	-78 42	-78 42	-78 42	-78 42	-78 42	-78 42	-78 42	-78 42
λ	0°	7°,5	15°	22°,5	30°	37°,5	45°	52°,5	60°	67°,5	75°	82°,5

TABLE (28) for the magnetic inclination, i /47

λ = / φ	90° i	97,5 i	105° i	112,5 i	120° i	127,5 i	135° i	142,5 i	150° i	157,5 i	165° i	172,5 i
+90	+86° 9'	+86° 9'	+86° 9'	+86° 9'	+86° 9'	+86° 9'	+86° 9'	+86° 9'	+86° 9'	+86° 9'	+86° 9'	+86° 9'
+85	+84 56	+85 10	+85 22	+85 34	+85 45	+85 55	+86 4	+86 12	+86 19	+86 24	+86 29	+86 32
+80	+83 57	+84 20	+84 41	+84 57	+85 8	+85 16	+85 20	+85 20	+85 19	+85 18	+85 18	+85 20
+75	+82 47	+83 15	+83 37	+83 50	+83 52	+83 46	+83 32	+83 15	+82 52	+82 44	+82 34	+82 30
+70	+81 6	+81 34	+81 52	+81 55	+81 44	+81 22	+80 52	+80 21	+79 51	+79 26	+79 7	+79 1
+65	+78 47	+79 13	+79 25	+79 20	+78 57	+78 21	+77 38	+76 55	+76 15	+75 43	+75 22	+75 15
+60	+75 52	+76 15	+76 23	+76 10	+75 39	+74 53	+74 0	+73 6	+72 13	+71 43	+71 21	+71 18
+55	+72 15	+72 32	+72 43	+72 27	+71 51	+70 57	+69 58	+68 59	+68 6	+67 30	+67 11	+67 15
+50	+68 0	+68 23	+68 30	+68 13	+67 35	+66 39	+65 33	+64 28	+63 33	+62 57	+62 46	+63 2
+45	+63 5	+63 31	+63 40	+63 27	+62 49	+61 51	+60 43	+59 37	+58 42	+58 15	+58 13	+58 46
+40	+57 26	+57 57	+58 13	+58 4	+57 29	+56 30	+55 23	+54 18	+53 26	+53 10	+53 22	+54 12
+35	+50 56	+51 35	+52 0	+51 58	+51 31	+50 37	+49 33	+48 32	+47 48	+47 44	+48 14	+49 26
+30	+43 29	+44 18	+44 54	+45 1	+44 45	+43 57	+42 58	+42 5	+41 32	+41 45	+42 35	+44 9
+25	+35 2	+36 5	+36 54	+37 12	+37 6	+36 23	+35 36	+34 54	+34 32	+35 4	+36 14	+38 11
+20	+25 31	+26 48	+27 51	+28 21	+28 27	+27 59	+27 21	+26 30	+26 42	+27 32	+29 6	+31 18
+15	+15 6	+16 34	+17 50	+18 32	+18 50	+18 33	+18 9	+17 51	+17 59	+19 7	+20 54	+23 38
+10	+4 0	+5 36	+7 2	+7 56	+8 25	+8 20	+8 11	+8 8	+8 32	+9 53	+11 53	+14 29
+5	-7 15	-5 36	-4 7	-3 6	-2 30	-2 22	-2 21	-2 9	-1 25	-0 3	+2 1	+4 38
0	-18 8	-16 33	-15 5	-14 2	-13 21	-13 4	-12 51	-12 24	-11 38	-10 6	-8 4	-5 39
-5	-28 12	-26 45	-25 25	-24 24	-23 44	-23 22	-23 1	-22 28	-21 33	-20 1	-18 9	-15 46
-10	-37 12	-35 56	-34 40	-33 54	-33 14	-32 49	-32 21	-31 43	-30 44	-29 17	-27 28	-25 22
-15	-45 3	-44 1	-43 4	-42 22	-41 47	-41 22	-40 51	-40 12	-39 12	-37 49	-36 7	-34 13
-20	-51 50	-51 1	-50 19	-49 47	-49 21	-48 58	-48 28	-47 45	-46 44	-45 26	-43 49	-42 5
-25	-57 41	-57 9	-56 40	-56 20	-56 1	-55 41	-55 12	-54 27	-53 27	-52 7	-50 33	-48 58
-30	-62 39	-62 23	-62 10	-62 2	-61 51	-61 36	-61 8	-60 29	-59 19	-58 0	-56 28	-54 52
-35	-66 42	-66 45	-66 48	-66 54	-66 55	-66 45	-66 19	-65 34	-64 28	-63 6	-61 35	-59 59
-40	-70 2	-70 25	-70 46	-71 6	-71 18	-71 15	-70 52	-70 5	-68 53	-67 37	-66 5	-64 30
-45	-72 41	-73 23	-74 2	-74 38	-75 2	-75 6	-74 47	-74 2	-72 56	-71 33	-70 0	-68 25
-50	-74 45	-75 45	-76 41	-77 33	-78 10	-78 26	-78 13	-77 39	-76 33	-75 5	-73 35	-72 8
-55	-76 16	-77 28	-78 40	-79 46	-80 39	-81 9	-81 7	-80 33	-79 34	-78 18	-76 54	-75 34
-60	-77 25	-78 45	-80 6	-81 25	-82 34	-83 22	-83 39	-83 18	-82 28	-81 20	-80 1	-78 52
-65	-78 15	-79 42	-81 6	-82 32	-83 53	-85 2	-85 46	-85 50	-85 17	-84 24	-83 14	-82 8
-70	-79 4	-80 22	-81 43	-83 7	-84 30	-85 51	-87 7	-87 53	-88 3	-87 18	-86 18	-85 16
-75	-79 42	-80 50	-81 57	-83 11	-84 22	-85 32	-86 45	-87 55	-88 56	-89 18	-88 29	-87 10
-80	-80 2	-80 52	-81 41	-82 34	-83 23	-84 9	-84 53	-85 31	-86 0	-86 18	-86 20	-86 9
-85	-79 43	-80 11	-80 36	-81 3	-81 27	-81 50	-82 9	-82 25	-82 37	-82 45	-82 48	-82 46
-90	-78 42	-78 42	-78 42	-78 42	-78 42	-78 42	-78 42	-78 42	-78 42	-78 42	-78 42	-78 42
λ =	90°	97,5	105°	112,5	120°	127,5	135°	142,5	150°	157,5	165°	172,5

TABLE (28) for the magnetic inclination, i

/48

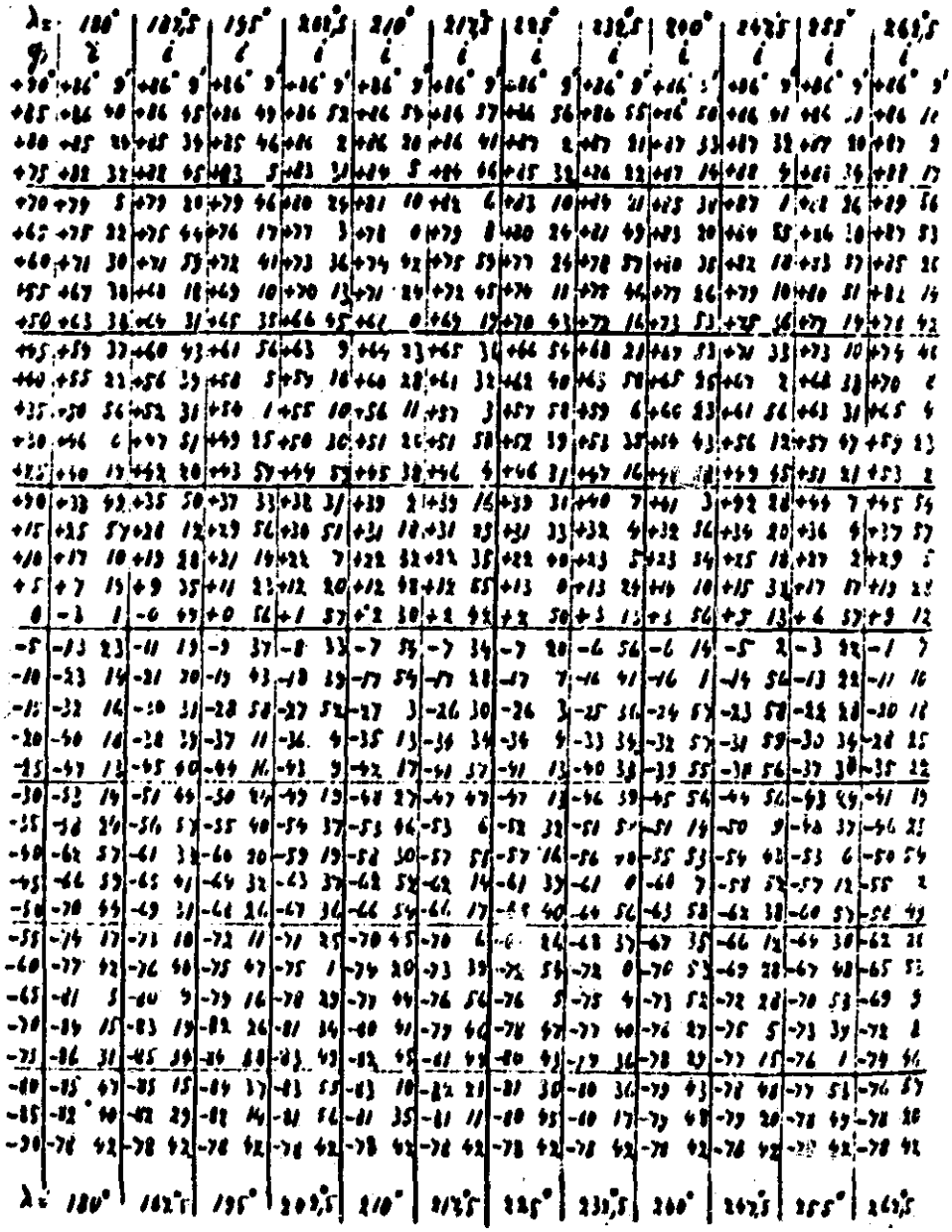

TABLE (28) for the magnetic inclination, i /49

λ = φ	270° i	277.5° i	285° i	292.5° i	300° i	307.5° i	315° i	322.5° i	330° i	337.5° i	345° i	352.5° i
+90	+86° 9'	+86° 9'	+86° 9'	+86° 9'	+86° 9'	+86° 9'	+86° 9'	+86° 9'	+86° 9'	+86° 9'	+86° 9'	+86° 9'
+85	+86 4	+85 49	+85 32	+85 14	+84 57	+84 41	+84 26	+84 12	+83 59	+83 48	+83 39	+83 32
+80	+86 32	+85 57	+85 20	+84 43	+84 7	+83 32	+83 0	+82 32	+82 7	+81 46	+81 30	+81 17
+75	+87 26	+86 28	+85 28	+84 30	+83 34	+82 41	+81 51	+81 9	+80 35	+80 5	+79 41	+79 24
+70	+88 35	+87 7	+85 41	+84 19	+83 2	+81 52	+80 48	+79 54	+79 6	+78 28	+77 56	+77 33
+65	+88 12	+87 4	+85 23	+83 53	+82 21	+80 58	+79 41	+78 35	+77 37	+76 49	+76 8	+75 37
+60	+86 3	+85 42	+84 30	+82 58	+81 22	+79 50	+78 24	+77 9	+76 1	+75 1	+74 10	+73 29
+55	+83 9	+83 16	+82 35	+81 22	+79 53	+78 19	+76 48	+75 24	+74 6	+72 55	+71 52	+70 58
+50	+79 45	+80 9	+79 54	+79 3	+77 48	+76 20	+74 48	+72 18	+71 52	+70 29	+69 10	+67 52
+45	+75 45	+76 26	+76 30	+76 0	+75 4	+73 48	+72 21	+70 48	+69 12	+67 33	+65 54	+64 21
+40	+71 23	+72 12	+72 32	+72 23	+71 46	+70 45	+69 26	+67 51	+66 5	+64 7	+62 6	+60 6
+35	+66 24	+67 24	+68 1	+68 10	+67 32	+67 9	+66 0	+64 24	+62 28	+60 40	+57 41	+55 9
+30	+60 50	+62 2	+62 55	+63 23	+63 26	+62 59	+62 2	+60 28	+58 20	+55 39	+52 35	+49 30
+25	+54 39	+56 3	+57 12	+58 0	+58 22	+58 15	+57 18	+55 54	+53 35	+50 23	+46 51	+43 0
+20	+47 41	+49 21	+50 48	+51 57	+52 43	+52 54	+52 10	+50 46	+48 14	+44 39	+40 22	+35 42
+15	+39 57	+41 53	+43 41	+45 19	+46 29	+47 1	+46 41	+45 5	+42 21	+38 14	+33 13	+27 44
+10	+31 57	+33 34	+35 51	+37 55	+39 35	+40 30	+40 21	+38 47	+35 47	+31 8	+25 24	+19 4
+5	+21 54	+24 34	+27 15	+29 52	+32 2	+33 21	+33 20	+31 48	+28 32	+23 21	+17 1	+10 1
0	+11 45	+14 50	+17 55	+21 9	+23 51	+25 34	+25 54	+24 10	+20 37	+15 2	+8 11	[illegible] 44
-5	+1 37	+4 57	+8 31	+12 12	+15 24	+17 23	+17 58	+16 12	+12 24	+6 23	-0 40	[illegible] 15
-10	-8 23	-4 51	-0 57	+3 7	+6 42	+9 7	+9 44	+7 52	+3 54	-2 9	-9 17	-16 44
-15	-17 25	-13 51	-9 45	-5 28	-1 42	+0 54	+1 36	-0 19	-4 19	-10 17	-17 12	-24 17
-20	-25 37	-21 58	-17 50	-13 30	-9 38	-7 8	-6 24	-8 17	-12 9	-17 58	-24 19	-30 53
-25	-32 35	-28 55	-24 57	-20 42	-16 56	-14 36	-13 47	-15 32	-19 9	-24 23	-30 20	-36 19
-30	-38 33	-35 4	-30 10	-27 10	-23 37	-21 22	-20 41	-22 14	-25 28	-30 9	-35 30	-40 52
-35	-43 41	-40 15	-36 39	-32 58	-29 44	-27 41	-27 1	-28 18	-31 4	-35 5	-39 44	-44 30
-40	-48 13	-45 0	-41 35	-38 17	-35 24	-33 35	-32 56	-33 55	-36 10	-39 31	-43 27	-47 36
-45	-52 26	-49 28	-46 21	-43 25	-40 49	-39 16	-38 37	-39 18	-41 0	-43 40	-46 54	-50 20
-50	-56 24	-53 35	-50 52	-48 17	-46 4	-44 35	-44 1	-44 23	-45 57	-47 35	-50 11	-52 58
-55	-60 12	-57 46	-55 20	-53 7	-51 15	-49 57	-49 15	-49 26	-50 13	-51 38	-53 31	-55 40
-60	-63 50	-61 41	-59 35	-57 43	-56 6	-54 59	-54 19	-54 16	-54 42	-55 37	-56 55	-58 31
-65	-67 20	-65 30	-63 45	-62 10	-60 56	-59 51	-59 12	-59 1	-59 11	-59 44	-60 34	-61 38
-70	-70 35	-69 4	-67 38	-66 21	-65 15	-64 24	-63 48	-63 31	-63 30	-63 48	-64 14	-64 57
-75	-73 31	-72 19	-71 11	-70 10	-69 20	-68 36	-68 6	-67 51	-67 43	-67 50	-68 4	-68 27
-80	-76 4	-75 13	-74 27	-73 45	-73 3	-72 23	-72 15	-71 59	-71 50	-71 47	-71 51	-72 2
-85	-77 53	-77 25	-77 0	-76 38	-76 18	-76 0	-75 48	-75 37	-75 30	-75 26	-75 25	-75 28
-90	-78 42	-78 42	-78 42	-78 42	-78 42	-78 42	-78 42	-78 42	-78 42	-78 42	-78 42	-78 42
λ =	270°	277.5°	285°	292.5°	300°	307.5°	315°	322.5°	330°	337.5°	345°	352.5°

TABLE (29) for the horizontal intensity, T.

λ= / φ	0° T	7°,5 T	15° T	22°,5 T	30° T	37°,5 T	45° T	52°,5 T	60° T	67°,5 T	75° T	82°,5 T
+90°	0,374	0,374	0,374	0,374	0,374	0,374	0,374	0,374	0,374	0,374	0,374	0,374
+85	0,623	0,626	0,626	0,624	0,619	0,610	0,598	0,584	0,568	0,551	0,533	0,514
+80	0,820	0,826	0,827	0,824	0,817	0,802	0,782	0,760	0,733	0,700	0,665	0,630
+75	0,971	0,978	0,982	0,980	0,974	0,962	0,944	0,919	0,886	0,848	0,805	0,760
+70	1,113	1,127	1,136	1,139	1,139	1,134	1,122	1,101	1,070	1,031	0,985	0,936
+65	1,260	1,281	1,299	1,310	1,318	1,323	1,320	1,308	1,286	1,252	1,212	1,166
+60	1,420	1,450	1,481	1,500	1,520	1,534	1,545	1,542	1,533	1,510	1,480	1,444
+55	1,609	1,651	1,691	1,725	1,754	1,781	1,801	1,812	1,815	1,808	1,791	1,768
+50	1,820	1,874	1,926	1,972	2,012	2,048	2,079	2,104	2,120	2,128	2,126	2,114
+45	2,057	2,122	2,186	2,241	2,291	2,335	2,375	2,409	2,436	2,456	2,463	2,465
+40	2,298	2,375	2,447	2,511	2,568	2,619	2,666	2,708	2,744	2,775	2,796	2,803
+35	2,532	2,617	2,695	2,763	2,824	2,881	2,933	2,982	3,025	3,065	3,094	3,108
+30	2,743	2,830	2,911	2,981	3,046	3,106	3,163	3,218	3,267	3,313	3,348	3,368
+25	2,913	2,995	3,075	3,145	3,213	3,278	3,338	3,397	3,451	3,500	3,540	3,565
+20	3,036	3,105	3,181	3,250	3,320	3,386	3,451	3,514	3,573	3,626	3,669	3,700
+15	3,097	3,157	3,219	3,282	3,350	3,419	3,488	3,557	3,621	3,679	3,730	3,769
+10	3,105	3,148	3,195	3,250	3,314	3,385	3,459	3,533	3,602	3,667	3,728	3,774
+5	3,056	3,078	3,107	3,152	3,211	3,282	3,359	3,436	3,513	3,586	3,654	3,713
0	2,967	2,968	2,978	3,009	3,060	3,128	3,206	3,286	3,369	3,449	3,525	3,603
-5	2,846	2,828	2,820	2,837	2,875	2,937	3,012	3,092	3,176	3,263	3,350	3,441
-10	2,706	2,673	2,648	2,650	2,674	2,725	2,792	2,867	2,951	3,041	3,135	3,240
-15	2,558	2,514	2,476	2,460	2,469	2,503	2,557	2,624	2,704	2,794	2,893	3,006
-20	2,418	2,361	2,311	2,282	2,274	2,290	2,327	2,381	2,452	2,538	2,638	2,753
-25	2,296	2,229	2,168	2,126	2,102	2,100	2,120	2,157	2,214	2,291	2,383	2,491
-30	2,198	2,123	2,053	1,998	1,959	1,941	1,943	1,963	2,003	2,065	2,143	2,235
-35	2,135	2,053	1,974	1,905	1,858	1,826	1,810	1,814	1,837	1,879	1,936	2,005
-40	2,100	2,012	1,928	1,855	1,793	1,747	1,718	1,707	1,711	1,732	1,764	1,805
-45	2,099	2,006	1,916	1,835	1,765	1,711	1,670	1,644	1,630	1,629	1,635	1,644
-50	2,116	2,018	1,925	1,840	1,765	1,705	1,653	1,614	1,583	1,561	1,541	1,517
-55	2,141	2,044	1,951	1,863	1,786	1,720	1,662	1,611	1,566	1,523	1,480	1,429
-60	2,159	2,065	1,975	1,888	1,810	1,741	1,678	1,617	1,559	1,499	1,436	1,363
-65	2,150	2,065	1,982	1,901	1,824	1,753	1,684	1,617	1,548	1,476	1,398	1,311
-70	2,099	2,027	1,955	1,881	1,809	1,739	1,669	1,598	1,524	1,443	1,357	1,262
-75	1,977	1,923	1,866	1,804	1,741	1,676	1,610	1,541	1,469	1,389	1,305	1,217
-80	1,795	1,759	1,719	1,674	1,626	1,573	1,517	1,457	1,393	1,327	1,255	1,181
-85	1,567	1,561	1,521	1,496	1,468	1,437	1,402	1,365	1,326	1,283	1,240	1,197
-90	1,275	1,275	1,275	1,275	1,275	1,275	1,275	1,275	1,275	1,275	1,275	1,275
λ=	0°	7°,5	15°	22°,5	30°	37°,5	45°	52°,5	60°	67°,5	75°	82°,5

TABLE (29), for the horizontal intensity, T. /51

$\lambda =$ / φ	90°	97,5°	105°	112,5°	120°	127,5°	135°	142,5°	150°	157,5°	165°	172,5°
	T	T	T	T	T	T	T	T	T	T	T	T
+90	0,374	0,374	0,374	0,374	0,374	0,374	0,374	0,374	0,374	0,374	0,374	0,374
+85	0,493	0,479	0,456	0,436	0,419	0,404	0,390	0,377	0,366	0,378	0,369	0,360
+80	0,536	0,518	0,499	0,505	0,487	0,473	0,460	0,470	0,472	0,474	0,478	0,478
+75	0,716	0,675	0,693	0,624	0,622	0,632	0,657	0,684	0,712	0,738	0,753	0,765
+70	0,889	0,851	0,828	0,835	0,864	0,892	0,925	0,977	1,022	1,059	1,086	1,094
+65	1,125	1,034	1,081	1,094	1,131	1,116	1,209	1,308	1,359	1,399	1,424	1,429
+60	1,411	1,389	1,386	1,409	1,455	1,518	1,587	1,648	1,698	1,730	1,746	1,752
+55	1,793	1,735	1,723	1,754	1,800	1,859	1,921	1,973	2,014	2,038	2,048	2,049
+50	2,099	2,091	2,089	2,118	2,166	2,193	2,240	2,275	2,296	2,299	2,292	2,288
+45	2,457	2,448	2,446	2,454	2,477	2,503	2,528	2,537	2,532	2,505	2,467	2,449
+40	2,800	2,790	2,781	2,776	2,779	2,784	2,781	2,763	2,738	2,684	2,627	2,568
+35	3,108	3,097	3,079	3,061	3,040	3,019	2,989	2,946	2,890	2,824	2,758	2,694
+30	3,372	3,360	3,336	3,303	3,264	3,219	3,165	3,098	3,025	2,947	2,876	2,814
+25	3,574	3,563	3,536	3,497	3,446	3,385	3,314	3,234	3,151	3,070	3,001	2,946
+20	3,716	3,710	3,686	3,646	3,591	3,523	3,443	3,356	3,270	3,194	3,138	3,080
+15	3,793	3,798	3,784	3,754	3,704	3,637	3,559	3,475	3,392	3,319	3,[illegible]	3,428
+10	3,811	3,831	3,834	3,818	3,782	3,735	3,681	3,620	3,508	3,447	3,399	3,369
+ 5	3,768	3,809	3,834	3,840	3,826	3,788	3,733	3,672	3,612	3,560	3,520	3,495
0	3,673	3,736	3,787	3,817	3,828	3,812	3,777	3,731	3,684	3,643	3,610	3,588
- 5	3,525	3,615	3,691	3,747	3,783	3,788	3,774	3,745	3,710	3,680	3,653	3,631
-10	3,344	3,450	3,547	3,625	3,683	3,709	3,715	3,703	3,681	3,655	3,640	3,628
-15	3,122	3,241	3,353	3,445	3,520	3,562	3,585	3,584	3,577	3,562	3,553	3,537
-20	2,874	2,998	3,115	3,214	3,292	3,345	3,381	3,398	3,406	3,409	3,404	3,399
-25	2,605	2,731	2,833	2,927	3,005	3,063	3,107	3,140	3,166	3,186	3,207	3,210
-30	2,333	2,433	2,528	2,608	2,677	2,733	2,784	2,831	2,877	2,921	2,957	2,985
-35	2,078	2,157	2,218	2,274	2,324	2,371	2,424	2,485	2,552	2,620	2,684	2,738
-40	1,847	1,883	1,916	1,960	1,965	1,998	2,049	2,121	2,207	2,300	2,391	2,473
-45	1,646	1,695	1,637	1,625	1,681	1,637	1,683	1,761	1,842	1,977	2,094	2,198
-50	1,467	1,444	1,395	1,344	1,306	1,298	1,334	1,410	1,521	1,652	1,786	1,909
-55	1,308	1,293	1,209	1,121	1,046	1,006	1,016	1,087	1,194	1,332	1,473	1,603
-60	1,178	1,179	1,069	0,960	0,833	0,760	0,736	0,780	0,877	1,006	1,145	1,277
-65	1,111	1,097	0,972	0,834	0,696	0,574	0,495	0,485	0,557	0,665	0,787	0,904
-70	1,159	1,042	0,915	0,775	0,629	0,479	0,338	0,238	0,238	0,332	0,442	0,566
-75	1,115	1,009	0,899	0,773	0,646	0,518	0,381	0,247	0,126	0,083	0,181	0,300
-80	1,101	1,020	0,938	0,848	0,762	0,670	0,598	0,528	0,494	0,440	0,438	0,460
-85	1,153	1,104	1,065	1,020	0,978	0,940	0,907	0,879	0,859	0,845	0,841	0,846
-90	1,275	1,275	1,275	1,275	1,275	1,275	1,275	1,275	1,275	1,275	1,275	1,275
$\lambda =$	90°	97,5°	105°	112,5°	120°	127,5°	135°	142,5°	150°	157,5°	165°	172,5°

TABLE (29) for the horizontal intensity, T

$\lambda =$ / φ	180°	187.5°	195°	202.5°	210°	217.5°	225°	232.5°	240°	247.5°	255°	262.5°
	T	T	T	T	T	T	T	T	T	T	T	T
+90°	0.374	0,374	0,374	0,374	0,374	0,374	0,374	0,374	0,374	0,374	0,374	0,374
+85	0,332	0,324	0,316	0,312	0,308	0.304	0,305	0,307	0,315	0,328	0,345	0,364
+80	0,464	0,448	0,448	0,401	0,372	0,336	0,301	0,269	0,249	0,246	0,246	0,298
+75	0,734	0,734	0,702	0,659	0,604	0,537	0,460	0,375	0,286	0,201	0,159	0,178
+70	1,088	1,065	1,026	0,970	0,900	0,812	0,709	0,590	0,458	0,316	0,165	0,001
+65	1,497	1,388	1,345	1,283	1,206	1,105	0,995	0,860	0,709	0,546	0,378	0,230
+60	1,723	1,618	1,661	1,580	1,503	1,407	1,294	1,159	1,006	0,835	0,663	0,513
+55	1,980	1,940	1,851	1,835	1,768	1,687	1,591	1,471	1,332	1,173	1,006	0,859
+50	2,198	2,153	2,107	2,061	2,010	1,953	1,882	1,790	1,676	1,538	1,391	1,266
+45	2,370	2,326	2,287	2,257	2,226	2,201	2,164	2,106	2,024	1,917	1,793	1,660
+40	2,516	2,480	2,445	2,433	2,427	2,431	2,428	2,408	2,365	2,289	2,192	2,078
+35	2,643	2,604	2,584	2,591	2,608	2,638	2,667	2,681	2,675	2,634	2,567	2,476
+30	2,746	2,734	2,726	2,743	2,778	2,828	2,881	2,924	2,950	2,942	2,905	2,836
+25	2,902	2,877	2,875	2,902	2,946	3,006	3,071	3,133	3,179	3,196	3,183	3,134
+20	3,059	3,034	3,036	3,060	3,105	3,164	3,230	3,298	3,356	3,390	3,395	3,364
+15	3,203	3,190	3,193	3,214	3,249	3,296	3,352	3,414	3,471	3,512	3,527	3,510
+10	3,350	3,338	3,338	3,367	3,366	3,396	3,435	3,483	3,530	3,569	3,592	3,581
+5	3,475	3,463	3,454	3,499	3,448	3,459	3,475	3,505	3,538	3,569	3,588	3,578
0	3,569	3,551	3,537	3,518	3,495	3,483	3,480	3,491	3,507	3,525	3,535	3,525
-5	3,606	3,583	3,555	3,524	3,495	3,467	3,448	3,444	3,445	3,450	3,447	3,428
-10	3,594	3,564	3,531	3,493	3,456	3,421	3,392	3,374	3,362	3,353	3,340	3,314
-15	3,515	3,487	3,456	3,419	3,381	3,345	3,315	3,292	3,270	3,250	3,238	3,199
-20	3,385	3,364	3,341	3,311	3,279	3,251	3,233	3,199	3,172	3,151	3,125	3,090
-25	3,219	3,204	3,193	3,178	3,159	3,140	3,117	3,100	3,078	3,056	3,035	3,002
-30	3,006	3,017	3,022	3,023	3,020	3,014	3,004	2,994	2,981	2,965	2,948	2,930
-35	2,763	2,817	2,853	2,862	2,874	2,881	2,883	2,881	2,879	2,877	2,877	2,878
-40	2,593	2,600	2,645	2,681	2,709	2,729	2,743	2,754	2,764	2,782	2,804	2,827
-45	2,290	2,366	2,430	2,477	2,517	2,547	2,574	2,598	2,628	2,668	2,714	2,763
-50	2,013	2,109	2,186	2,245	2,298	2,334	2,373	2,418	2,465	2,529	2,593	2,655
-55	1,782	1,882	1,988	1,975	2,051	2,084	2,135	2,195	2,265	2,351	2,447	2,546
-60	1,399	1,505	1,596	1,671	1,739	1,804	1,871	1,949	2,039	2,145	2,261	2,380
-65	1,044	1,151	1,248	1,334	1,415	1,495	1,585	1,689	1,795	1,916	2,045	2,174
-70	0,686	0,797	0,902	1,003	1,103	1,206	1,311	1,431	1,553	1,685	1,816	1,943
-75	0,419	0,534	0,645	0,757	0,869	0,986	1,101	1,222	1,342	1,469	1,589	1,704
-80	0,586	0,569	0,444	0,727	0,817	0,911	1,007	1,107	1,203	1,300	1,393	1,484
-85	0,860	0,282	0,511	0,546	0,546	1,030	1,078	1,128	1,179	1,228	1,281	1,330
-90	1,275	1,275	1,275	1,275	1,275	1,275	1,275	1,275	1,275	1,275	1,275	1,275
$\lambda =$	180°	187.5°	195°	202.5°	210°	217.5°	225°	232.5°	240°	247.5°	255°	262.5°

TABLE (29) for the horizontal intensity, $\mathcal{T}$.

$\lambda =$ / φ	270°	277,5°	285°	292,5°	300°	307,5°	315°	322,5°	330°	337,5°	345°	352,5°
	$\mathcal{T}$	$\mathcal{T}$	$\mathcal{T}$	$\mathcal{T}$	$\mathcal{T}$	$\mathcal{T}$	$\mathcal{T}$	$\mathcal{T}$	$\mathcal{T}$	$\mathcal{T}$	$\mathcal{T}$	$\mathcal{T}$
+90°	0,374	0,374	0,374	0,374	0,374	0,374	0,374	0,374	0,374	0,374	0,374	0,374
+85	0,388	0,410	0,437	0,464	0,491	0,515	0,537	0,557	0,576	0,592	0,605	0,615
+80	0,367	0,401	0,443	0,520	0,574	0,625	0,671	0,710	0,744	0,770	0,792	0,809
+75	0,360	0,360	0,456	0,547	0,638	0,707	0,777	0,831	0,874	0,908	0,936	0,955
+70	0,348	0,300	0,464	0,575	0,692	0,791	0,876	0,944	0,999	1,039	1,071	1,095
+65	0,194	0,313	0,475	0,630	0,769	0,886	0,984	1,060	1,121	1,169	1,207	1,236
+60	0,432	0,466	0,588	0,734	0,877	1,001	1,107	1,188	1,254	1,308	1,352	1,387
+55	0,759	0,739	0,800	0,909	1,034	1,153	1,257	1,340	1,408	1,468	1,518	1,564
+50	1,134	1,081	1,091	1,154	1,245	1,342	1436	1,513	1,582	1,645	1,705	1,762
+45	1,546	1,470	1,441	1,456	1,504	1,569	1,660	1,708	1,775	1,844	1,915	1,985
+40	1,967	1,876	1,816	1,789	1,793	1,826	1,862	1,918	1,981	2,055	2,134	2,214
+35	2,375	2,275	2,190	2,128	2,092	2,081	2,094	2,133	2,190	2,266	2,351	2,442
+30	2,747	2,645	2,563	2,502	2,381	2,336	2,321	2,341	2,391	2,467	2,555	2,649
+25	3,058	2,958	2,864	2,737	2,639	2,567	2,529	2,534	2,575	2,645	2,731	2,822
+20	3,301	3,206	3,093	2,978	2,854	2,763	2,706	2,698	2,728	2,792	2,871	2,955
+15	3,458	3,371	3,258	3,129	3,003	2,900	2,838	2,814	2,835	2,891	2,962	3,038
+10	3,539	3,458	3,346	3,221	3,092	2,985	2,918	2,886	2,899	2,946	3,004	3,057
+5	3,539	3,464	3,363	3,240	3,115	3,011	2,938	2,911	2,919	2,958	2,994	3,030
0	3,485	3,413	3,317	3,203	3,087	2,990	2,921	2,894	2,899	2,928	2,968	2,961
-5	3,388	3,318	3,225	3,142	3,014	2,923	2,860	2,833	2,835	2,868	2,860	2,860
-10	3,270	3,203	3,114	3,019	2,918	2,834	2,775	2,748	2,761	2,751	2,752	2,737
-15	3,152	3,088	3,008	2,917	2,823	2,743	2,687	2,656	2,648	2,644	2,638	2,603
-20	3,045	2,985	2,912	2,828	2,740	2,663	2,606	2,570	2,559	2,539	2,516	2,478
-25	2,965	2,913	2,848	2,773	2,687	2,613	2,554	2,503	2,470	2,451	2,415	2,361
-30	2,905	2,867	2,815	2,747	2,670	2,592	2,524	2,471	2,429	2,386	2,336	2,272
-35	2,873	2,854	2,819	2,762	2,691	2,614	2,543	2,476	2,418	2,357	2,293	2,218
-40	2,864	2,849	2,831	2,791	2,738	2,656	2,582	2,503	2,431	2,355	2,277	2,191
-45	2,867	2,837	2,844	2,821	2,776	2,710	2,635	2,551	2,469	2,381	2,290	2,196
-50	2,745	2,799	2,838	2,829	2,803	2,749	2,679	2,597	2,510	2,414	2,317	2,216
-55	2,638	2,715	2,768	2,789	2,784	2,747	2,691	2,617	2,534	2,441	2,344	2,243
-60	2,545	2,585	2,656	2,695	2,711	2,695	2,657	2,598	2,525	2,442	2,351	2,256
-65	2,892	2,395	2,479	2,536	2,567	2,572	2,554	2,515	2,460	2,393	2,318	2,236
-70	2,061	2,147	2,255	2,341	2,385	2,387	2,389	2,370	2,334	2,285	2,234	2,166
-75	1,813	1,908	1,992	2,052	2,101	2,121	2,154	2,149	2,136	2,106	2,072	2,028
-80	1,567	1,642	1,707	1,762	1,807	1,846	1,881	1,872	1,874	1,866	1,849	1,825
-85	1,374	1,418	1,457	1,496	1,528	1,540	1,558	1,570	1,578	1,580	1,577	1,569
-90	1,275	1,275	1,275	1,275	1,275	1,275	1,275	1,275	1,275	1,275	1,275	1,275
$\lambda =$	270°	277,5°	285°	292,5°	300°	307,5°	315°	322,5°	330°	337,5°	345°	352,5°

When interpolating any of the values δ or i of the above tables (27) and (28) and using only the first differences while neglecting the higher differences, then the error seldom exceeds 0.1°; only in the neighborhood of the magnetic pole does it become greater, especially in the case of the error in δ. The interpolation of the horizontal intensity, τ, from table (20) will yield a result exact to within ±0,001 in most cases, if only the first difference is considered. /54

The position of the magnetic pole of the Earth is found most precisely from tables (24) and (25) for X and Y, which were computed from the theory, since both the latter must together equal zero at the poles, because there the horizontal intensity $\tau = \sqrt{X^2+Y^2}$ vanishes, and the lines on which X and Y = 0 intersect near the terrestrial pole at angles which differ very little from 30° (cf., e.g., the Atlas of the Earth's magnetism). By this method, I found for the coordinates:

	Latitude	Longitude
of the magnetic North Pole	+69°57'	262°45'
of the magnetic South Pole	-73°45'	153°0', with an uncertainty of ±15',
	Latitude	Longitude
for the magnetic North Pole	+70°30'	262°20'
for the magnetic South Pole	-73°39'	146°15'

The longitude and latitude of the magnetic North Pole, and also the latitude of the South Pole are almost the same according to both determinations (valid for the year 1885); on the other hand, the longitude of the magnetic South Pole according to my computation by means of the theory is about 7° greater than according to Neumayer's chart: which may well be due mainly to an error in the chart. The fact that in the latter the position of the South Pole is incorrectly entered is proved by the large differences $= \delta_r - \delta_c$ of the immediate following table (30) which appear in the vicinity of the magnetic South Pole.

δ_r of table (30) is the declination given in table (27) and computed with the help of 46 coefficients; cf. the above equations (21), (22), (23) and δ_c is the declination of the Neumayer chart according to the above table (1). Likewise the quantities $\Delta i = i_r - i_b$ and $\Delta\tau = \tau_r - \tau_b$ are respectively the differences between the inclination i_r of table (28) computed according to the theory cf. equations (21), (22), (23), or between the horizontal intensity τ_r of table (29), and that of Neumayer's chart--i_b or τ_b.

Since the local anomalies do not appear on Neumayer's charts, /57
the remainders $\delta_r - \delta_b$, $i_r - i_b$ and $\tau_r - \tau_b$ consist essentially of two parts: 1) of the terrestrial anomaly which is due to disturbing magnetic masses, occurring on or very near the surface of the Earth and not lying much too close to the place of observation, and 2) of systematic and chance errors of the charts used by me based on observations[1].

According to Dr. Neumayer's calculations (cf. page 20 of the text to his Atlas), in the temperate latitudes and tropics, there appear for $\delta_r-\delta_b$ values from +6° to -6°. On the contrary, according to my calculations, table (30), within the latitudes +50° and -50°, the quantity $\delta_r-\delta_b$ varies only between the limits +2.8° (λ=120°, ϕ=-50°) and -2.1° (λ=240°, ϕ =0°); for the preponderant majority, however--for about 200 or the 264 points contained in table (30)--between the latitudes +50° and -50° and the longitudes 0° to 360° the quantity $\delta_r-\delta_b$ is smaller than a degree, and in the average of these 264 points without regard to sign, $\delta_r-\delta_b = \pm 0.69° = \pm 41.4'$. From latitude +60° to +90°, this quantity grows toward the north,

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1) The elements δ, i, τ actually observed by us are, when we proceed from the Gaussian theory, the sums of three parts: 1) the term, G, which the theory yields, 2) the terrestrial anomaly A and 3) the local anomaly, a, which I called the "local deviation" in my earlier papers, and which usually for δ and i is ±15' and for τ = $\pm\tau/100$, but in many cases can attain any arbitrary quantity. To compute δ, i, τ, we form the sum G-A + a, where A represents the values of the tables (30), (31), (32).

TABLE (30) for $\Delta\delta = \delta_r - \delta_b$. Declination: Calculation - Observation

Differences between the theory and the terrestrial lines of the magnetic chart of Neumayer for 1885

$\lambda =$ / φ	0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	180°	195°	210°	225°	240°	255°	270°	285°	300°	315°	330°	345°
+80°	+4,3	+2,3	+3,7	+2,8	+2,5	+2,6	+4,3	+2,9	+0,3	+0,1	-0,2	-2,4	-3,5	-5,4	-9,3	-13,5	-12,9	± 6,6	-2,5	-0,2	+2,9	+3,1	+ 2,9	+4,9
+70	+2,0	+0,3	+0,3	+0,8	+0,6	+1,7	+1,1	0,0	+2,3	+3,6	+3,1	+2,9	+1,9	+0,5	+0,4	-0,5	+0,4	+1,9	+19,1	+0,9	+1,7	+2,0	+0,7	+0,9
+60	+0,2	-0,9	-0,5	0,0	+1,0	+1,4	+0,3	-0,4	+0,5	-0,4	-0,4	+0,7	+1,3	+0,4	-1,5	-2,5	-2,5	-3,4	-3,5	+3,9	+1,3	0,0	-0,5	-0,5
+50	+0,7	-0,9	-0,3	0,0	+0,9	+1,8	+1,3	+0,1	0,0	-0,3	-0,3	+1,1	+1,7	+0,2	-0,7	-1,3	-1,4	-0,7	-0,7	-0,6	+1,2	+0,9	0,0	+0,5
+40	+1,1	-0,6	-1,1	-0,4	+0,6	+1,2	+1,7	+0,6	-0,2	-0,9	+0,1	+0,7	+1,0	-0,7	-0,9	-0,6	-0,6	+0,1	+0,1	+0,3	+0,1	+0,5	+0,3	+1,1
+30	+2,0	+0,1	-1,1	-0,1	-0,3	0,0	+1,1	+0,2	0,0	-0,3	+0,4	+0,3	0,1	-0,3	-0,4	-0,4	-0,3	-0,4	-0,3	0,0	+0,6	+0,5	-0,1	+1,8
+20	+1,8	+0,2	-1,1	-1,1	-0,7	-0,5	+0,2	+1,1	+0,5	+0,2	+0,3	+0,2	-0,2	-0,9	-0,4	-0,2	-0,8	-1,0	-0,7	-0,1	+0,7	+0,7	-1,1	+1,1
+10	+1,5	+0,3	-0,2	-1,1	-0,8	-0,6	+0,1	+1,2	+0,7	0,0	+0,2	+0,2	0,0	-0,5	-0,6	-1,3	-1,7	-1,6	-0,7	-0,4	+0,7	+1,1	-1,2	0,0
0	+1,1	+0,6	-0,4	-0,8	-0,3	-0,5	+0,2	+0,9	+0,9	+0,2	+0,3	+0,4	+0,1	-0,2	-1,2	-1,7	-2,1	-1,3	+0,1	-0,6	-0,2	+0,2	-1,6	-0,8
-10	+0,1	+0,2	-0,3	-0,7	-0,4	-0,4	-0,1	+1,0	+0,8	+0,3	+0,3	+0,3	0,0	-0,1	-0,9	-1,0	-0,8	-0,4	+0,5	-0,6	-0,9	-0,3	-1,1	-1,4
-20	-0,4	-0,2	-0,4	-0,5	+0,2	-0,4	-0,3	+0,5	+1,0	+0,5	+0,1	-0,4	-0,9	-0,6	-0,3	-0,2	-0,3	-0,5	-0,3	-1,0	-1,5	-0,6	-0,2	-0,5
-30	-0,4	-1,1	-1,4	-1,6	-0,4	-0,5	-1,1	+0,2	+1,1	+0,4	-0,2	-1,1	-1,3	-1,2	-0,4	+0,1	-0,4	-1,2	-0,7	-1,1	-1,7	-0,5	+0,7	+0,9
-40	+0,3	-0,4	-1,1	-1,3	-0,7	-0,8	-0,3	+0,3	+1,8	+0,3	-1,2	-1,7	-1,8	-1,3	-0,3	-0,1	-0,9	-1,4	-0,5	-0,9	-0,9	-0,3	+0,5	+1,1
-50	-0,2	-0,6	-0,9	-1,3	-0,6	-0,2	-0,2	+1,2	+2,8	+1,3	-1,4	-1,4	-1,6	-1,2	-0,7	-0,7	-1,4	-1,4	+0,1	-0,1	0,0	-0,2	+0,1	+0,3
-60	-0,4	-1,1	-0,7	-0,3	-0,8	-2,6	-2,7	+4,2	+10,3	+4,6	+0,1	-0,2	-1,6	-2,5	-3,1	-3,4	-3,2	-2,0	+1,2	+1,7	+0,7	+0,3	+0,4	+0,1
-70	+0,9	+0,2	+1,2	+2,6	+1,8	-2,7	-3,1	+3,2	+13,1	+35,7	+16,8	+2,5	-2,7	-4,3	-6,6	-8,3	-7,8	-4,2	+0,2	+1,7	+0,6	-0,4	+0,6	-0,4
-80	+1,3	+3,4	+2,3	+2,8	+2,6	+2,3	+4,5	+0,1	-7,8	-12,5	-14,4	-13,4	-11,8	-5,8	-5,7	-6,3	-7,1	-7,3	-7,7	-6,4	-6,4	-3,1	-2,1	-0,8

TABLE (31) $\Delta i = i_r - i_b$ = calculation-observation

Inclination.

$\lambda =$ / φ	0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	180°	195°	210°	225°	240°	255°	270°	285°	300°	315°	330°	345°
+90°	+0,5																							
+80	-0,2	0,0	0,0	+0,1	+0,3	+0,4	+0,2	+0,3	-0,1	-0,4	-0,1	-0,3	0,0	-0,4	-0,4	-0,3	-0,4	-0,9	-0,5	-0,5	+0,1	-0,3	-0,2	-0,2
+70	+0,5	+0,3	+0,1	+0,0	+0,1	+0,9	+1,0	+1,4	+1,5	+0,9	+0,6	+0,5	+0,6	0,0	+0,3	+0,3	+0,6	+0,1	+0,1	0,0	0,0	+0,2	0,0	+0,2
+60	+0,9	+0,6	+1,4	+1,2	+1,4	+1,4	+1,6	+1,8	+1,6	+1,1	+1,1	+1,0	+1,2	+0,8	+0,5	+0,5	+0,4	+0,6	+0,7	+0,3	+0,5	+0,1	+0,2	+0,4
+50	+0,7	+0,5	+1,0	+1,0	+0,9	+1,3	+1,6	+1,1	+0,6	0,0	+0,7	+1,3	+1,2	+1,1	+1,2	+0,6	+0,6	+0,5	+0,1	+0,2	+0,8	+0,1	+0,3	+0,2
+40	-0,1	0,0	+0,6	+0,9	+0,8	+1,0	+1,2	+1,3	+0,8	+0,4	+0,8	+1,4	+1,5	+1,5	+1,5	+1,3	+1,4	+0,7	+0,9	+1,1	+0,6	+0,2	+0,1	0,0
+30	-1,4	-0,9	0,0	-0,2	+0,3	-0,5	-0,1	-0,1	-0,1	-0,1	+1,3	+1,9	+2,1	+2,1	+1,4	+0,1	+0,1	+0,2	+0,3	+0,3	+0,6	0,0	-0,3	-1,4
+20	+1,1	+1,6	+1,1	+0,7	+0,8	+1,1	+0,7	+0,6	-0,2	-0,6	+0,5	+2,7	+3,8	+2,3	+0,8	-0,7	-0,8	-0,1	+0,8	+1,0	+0,7	-0,4	-0,8	-2,8

TABLE (31) for $\Delta i = i_r - i_b$ continued

λ / φ	0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	180°	195°	210°	225°	240°	255°	270°	285°	300°	315°	330°	345°	λ / φ
+10°	+3,1	+2,6	0,8	-1,1	-0,6	+0,6	+1,0	+0,2	-0,2	-1,8	+0,5	+1,3	+3,2	+1,4	+0,8	-0,8	-0,6	0,0	+1,1	-0,1	-0,4	-0,6	+0,3	-0,4	+10°
0	+3,2	+2,3	+1,9	+0,9	-0,2	-0,1	+1,4	+0,7	+0,1	-0,6	-0,3	+0,3	+0,9	+0,5	+0,3	+0,3	+0,3	+0,3	-0,2	+0,5	+0,1	-0,4	+0,3	+0,5	0
-10	-1,4	+0,6	+1,6	+1,0	+1,1	+0,3	+0,4	-0,3	-0,7	-0,7	0,0	-0,2	-0,7	-0,2	-0,3	-1,3	-1,0	-2,4	-2,4	-0,3	0,0	-0,3	-1,1	-2,0	-10
-20	-1,2	-0,2	+0,1	+0,2	+0,6	+0,2	+0,5	+0,3	+0,7	-0,1	0,0	-1,0	-0,3	-0,5	+0,4	+0,7	-0,5	-1,0	-1,6	+0,2	+0,4	+0,2	-1,4	-3,4	-20
-30	-0,4	-2,0	-1,4	-1,0	-0,7	-0,7	-0,6	-0,3	+0,1	0,0	+0,2	-0,5	+0,3	-0,2	+0,5	+0,8	+1,3	-0,5	-0,7	-0,3	+1,0	-0,4	-0,5	-1,3	-30
-40	-0,4	-1,5	-1,5	-1,3	-1,0	-0,2	-1,0	-1,2	-1,3	-0,9	-0,6	-0,1	+0,5	+0,2	+0,5	+0,2	+0,2	+0,5	+0,8	+0,5	0,0	+0,3	+0,2	+0,6	-40
-50	+0,4	-0,1	-0,3	-0,5	-0,2	-0,5	-0,5	-0,7	-0,2	-0,9	-0,3	-0,1	+0,1	0,0	-0,4	-0,3	-0,4	+0,1	+0,6	+0,3	-0,3	-0,5	+0,3	+0,8	-50
-60	+0,7	+1,2	+0,8	+0,7	+0,5	+0,6	+0,6	+0,8	+0,2	-0,3	-0,5	-0,5	-0,2	+0,2	+0,2	+0,5	+1,1	-0,1	+0,2	-0,6	-1,6	-1,3	-0,2	+0,4	-60
-70	+0,5	+1,0	+1,4	+1,4	+1,1	+1,2	+1,1	+1,7	+1,7	+0,7	0,0	-0,3	+0,3	+0,3	+0,5	+0,5	+0,1	0,0	0,0	+0,1	-0,2	-1,0	-0,6	0,0	-70
-80	+0,1	+0,7	+0,9	+0,9	+0,8	+1,0	+1,2	+0,8	+0,4	+0,1	0,0	-0,1	0,0	+0,2	+0,2	+0,2	+0,3	0,0	0,0	+0,1	-0,4	-0,5	0,0	+0,1	-80
-90	+0,3																								-90

TABLE (32) for $\Delta\tau = \tau_r - \tau_b$ = calculation-observation in Gaussian units of the second decimal place

λ / φ	0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	180°	195°	210°	225°	240°	255°	270°	285°	300°	315	330°	345°	λ / φ
+80°	-1																								+80°
+70	-1	0	+1	+1	+3	+2	+4	+4	+1	+1	0	+1	+3	+3	+4	+6	+10	+12	+5	+3	0	0	-2	-3	+70
+60	-7	-6	-6	-7	-8	-11	-11	-11	-11	-7	-5	-4	-6	-6	-3	-3	-4	-2	+1	-5	-5	-3	-4	-5	+60
+50	-8	-10	-14	-15	-16	-13	-15	-15	-14	-7	-3	-3	-7	-7	-5	-7	-7	-7	-1	-1	-2	-2	-3	-5	+50
+40	-5	-6	-4	-7	-7	-5	-8	-9	-5	-6	-5	-7	-10	-12	-15	-11	-9	-9	-7	-6	-6	-1	0	0	+40
+30	0	+4	+1	-3	-5	-4	-8	-9	-6	-5	-7	-7	-6	-6	-7	-7	-4	-7	-7	-11	-3	+6	+6	+3	+30
+20	+6	+6	+5	-2	-7	-8	-8	-7	-7	-4	-7	-10	-8	-7	-4	-3	+2	0	-8	-16	-6	+2	+7	+5	+20
+10	+9	+7	+4	+1	-4	-10	-7	-1	-2	-4	-7	-10	-11	-9	-2	+2	+1	+1	-1	-6	-7	-4	+1	+6	+10
0	-2	-3	0	+4	+7	+2	-1	+1	-1	-3	-7	-10	-11	-10	-3	+1	-5	-4	-4	+1	+3	-10	-5	-1	0
-10	-1	-2	+1	+5	+7	+4	+1	-1	0	-2	-6	-5	-12	-9	-3	-2	-3	-4	-2	+1	+4	-7	-6	-2	-10
-20	+5	+5	+3	+6	+5	0	-3	-2	0	-1	-1	-2	-9	-8	-4	-2	-4	-5	-6	0	+1	-3	+1	+5	-20
-30	+2	+3	0	0	+1	-1	+2	+1	-1	-4	-9	-9	-10	-7	-5	-1	-2	-5	-5	+1	-1	-2	+2	+7	-30
-40	+3	-2	-7	-9	-9	-7	-3	+1	-2	-7	-4	-4	-6	-6	-2	+1	+3	+3	+1	-2	-1	-1	+3	+5	-40
-50	+2	-2	-8	-11	-10	-10	-6	-7	-11	-11	-3	-1	+2	-1	+3	+5	+6	+5	+2	-1	0	+1	+4	+5	-50
-60	+5	+2	-2	-6	-5	-5	-5	-10	-15	-16	-10	-2	+2	+3	+4	+6	+6	+3	+2	0	0	+4	+5	+5	-60
-70	+12	+13	+9	+7	+7	+7	+7	+8	+5	-1	-3	-2	0	0	-3	-3	-5	-4	-3	-3	0	+6	+10	+11	-70
-80	+17	+17	+15	+14	+13	+16	+11	+12	+12	+23	-4	-6	-3	-2	-10	-9	-10	-8	-3	+2	+6	+11	+14	+16	-80
-90	+11	+13	+14	+12	+11	+12	+11	+13	+8	+11	+7	+7	+7	+4	0	+1	-2	-1	+1	-1	+1	+6	+8	+10	-90
	+13																								

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however, principally towards the northern magnetic pole ($\lambda = 263°$, $\phi = +70°$), where, according to Table (30), the greatest deviation in the northern hemisphere, below longitude 270° and latitude +70° amounts to +14.1°, while Prof. Neumayer gives -25° as the greatest value of $\delta_r - \delta_b$ for the location $\lambda = 270°$, $\phi = +1.5°$, for which I obtain +5° by interpolation from my table (30).

Nevertheless, no very great significance is to be attributed to large deviations of $\delta_r - \delta_b$ in the neighborhood of the magnetic pole since there the declination changes very rapidly--almost discontinuously--and even a small local disturbing cause may evoke a considerable deflection of the compass needle due to the weakness of the horizontal force.

In the vicinity of the magnetic pole $\delta_r - \delta_b$ is much greater than near the magnetic North Pole, according to (30), which may well be attributable mainly to the calculation of the erroneous position of the South Pole in the chart. As regards the discrepancies in inclination between theory and observation, the quantities $i_r - i_b$ are somewhat smaller near the pole, according to table (31), than in the middle and lower latitudes; values for $i_r - i_b$, from 5° and -4°, which Prof. Neumayer has found (page 20 of the text of the Atlas) do not appear in our table (31): most such differences in (31) are smaller than 1°. Only once do we encounter +3.8° at longitude 180° and latitude +20°, and if we disregard the two poles, then the mean of the 408 value of $i_r - i_b = \pm 0.686° = \pm 41.2'$.

For the deviations $\tau_r - \tau_b$ of the horizontal intensity τ_r calculated by means of the theory from the τ_b taken from the chart, according to table (32), the same values recur at all longitudes and latitudes ; only in the southern latitudes -70° and -80° are they /58
especially large, which is clearly caused by systematic errors of all the 408 locations of table (32) $\tau_r - \tau_b = \pm 0.056$ Gaussian units or circa 1/40, i.e., 2-1/2% of the horizontal intensity τ, if we assume that τ equals on the average 2 Gaussian units.

The deviations $\delta_r - \delta_b$, $i_r - i_b$, $\tau_r - \tau_b$ on the tables (30), (31), (32) have for the most part a systematic, rather than chance, character since they do not often suddenly change their sign, but a series of positive signs follows a series of negative signs and, conversely, which must be ascribed in part to the wide distribution of significant, extensive (terrestrial) anomalies and in part also to the systematic errors of the charts which I have used as a basis for the theory.

If we wanted an even closer connection between theory and observation by assuming the presence of vertical electrical currents [1], generated by rotation of the magnetic terrestrial sphere, and going from the air into the Earth and, conversely, in meridional closed paths, then we may set the quantity l_o of our above table (6) $\neq 0$, provided that we regard the currents solely as a function of the latitude, ϕ, but not of the longitude, λ. l_o is derived from observation, and should be 0 according to the Gaussian potential theory of magnetic masses. Then, according to table (6), the deflecting force of the currents would be directed into the meridians from the astronomical North Pole toward the east to latitude +20°, from there to latitude -55° toward the west, and from there to the South Pole, again toward the east. In order to remove the accidental errors from $l_o = \Delta y$ as far as possible, I have derived the table $(6)_\alpha$ from (6) by means of a curve and thereby the changes $\Delta\delta_r$ from δ_r, $\Delta\tau_r$ from τ_r, and Δi_r from i_r, resulting from $\Delta y = l_o$, calculated according to the formulas (33):

$$\Delta\delta_r = \frac{\cos i}{T \sin i^0} \cdot \Delta y \quad , \Delta\tau_r = \sin i \cdot \Delta y \, , \Delta i_r = -\frac{\sin i \cos i}{\sin i^0} \cdot \frac{\Delta T}{T}$$

TABLE $(6)_\alpha$

$\varphi =$	+20°	+30°	+40°	+50°	+60°	+70°	+80°	0°	-10°	-20°	-30°	-40°	-50°	-60°	-70°	-80°
$\Delta y = l_o$	-0,006	-0,011	-0,011	-0,011	-0,011	-0,007	0,000	+0,003	+0,011	+0,011	+0,013	+0,013	+0,012	+0,015	+0,010	+0,005

1) Hertz: "On Induction in Rotating Spheres", inaugural dissertation, Berlin University, 1880, and

Dr. A. Bauer: "Vertical Earth-Air Electric Currents" in the journal "Terrestrial Magnetism". University of Cincinnati, Ohio, March 1887, No. 1, Vol. II.

TABLE (3) differences $\delta_p - \delta_b + \Delta\delta_p$ between theory and chart with consideration of possible vertical electrical currents

TABLE 31 (continued)

λ = φ	0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	180°	195°	210°	225°	240°	255°	270°	285°	300°	315°	330°	345°
-10°	-4,4	+0,6	+1,6	+1,0	+1,1	+0,3	+0,4	-0,3	-0,7	-0,7	0,0	-0,2	-0,7	-0,2	-0,3	-1,3	-1,0	-2,4	-2,4	-0,9	0,0	-0,3	-1,1	-2,6
-20	-1,1	-0,7	+0,2	+0,8	+0,6	+0,2	+0,5	+0,3	+0,7	-0,1	0,0	-1,0	-0,3	-0,5	+0,4	+0,7	-0,5	-1,0	-1,6	+0,2	+0,4	+0,8	-0,4	-1,9
-30	-0,8	-1,9	-1,3	-0,9	-0,6	-0,7	-0,6	-0,3	+0,1	0,0	+0,2	-0,5	+0,3	-0,3	+0,5	+0,8	+1,3	-0,5	-0,7	-0,3	+1,0	-0,4	-0,5	-1,2
-40	-0,2	-1,3	-1,3	-1,1	-0,9	-0,7	-0,9	-1,1	-1,3	-0,9	-0,6	-0,2	+0,4	+0,1	+0,4	+0,1	+0,1	+0,4	+0,7	+0,4	-0,1	+0,3	+1,3	+0,7
-50	+0,5	0,0	-0,2	-0,4	-0,1	-0,4	-0,4	-0,6	-0,8	-0,9	-0,3	-0,1	+0,1	0,0	-0,4	-0,3	-0,4	+0,1	+0,6	+0,3	-0,3	-0,5	+0,2	+0,8
-60	+0,6	+0,1	+0,7	+0,6	+0,4	+0,5	+0,5	+0,7	+0,1	-0,3	-0,5	-0,6	-0,1	+0,2	+0,3	+0,6	+1,2	0,0	+0,3	-0,5	-1,6	-1,3	-0,2	+0,4
-70	+0,4	+0,8	+1,2	+1,1	+0,8	+0,9	+0,8	+1,4	+1,4	+0,4	0,0	-0,1	+0,5	+0,5	+0,7	+0,6	+0,3	+0,2	+0,2	+0,3	-0,1	-0,3	-0,6	-0,1
-80	0,0	+0,6	+0,7	+0,7	+0,5	+0,7	+0,9	+0,5	+0,1	+0,5	-0,1	0,0	+0,2	+0,5	+0,5	+0,5	+0,6	+0,3	+0,2	+0,3	-0,3	-0,4	0,0	+0,1

TABLE (32)$_\alpha$ $\tau_r - \tau_b + \Delta\tau_r$ = differences between theory and chart with consideration of possible vertical electrical currents of Gaussian units of the second decimal place

λ = φ	0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	180°	195°	210°	225°	240°	255°	270°	285°	300°	315°	330°	345°
+80°	-1	0	+1	+1	+3	+2	+4	+4	+1	+1	0	+1	+3	+4	+5	+7	+10	+12	+9	+2	-1	-1	-3	-3
+70	-7	-6	-6	-7	-8	-11	-11	-11	-11	-7	-5	-4	-6	-5	-2	-2	-3	-1	0	-6	-6	-4	-5	-6
+60	-8	-10	-14	-15	-16	-13	-15	-15	-14	-7	-3	-3	-7	-7	-8	-6	-6	-6	-1	-2	-3	-3	-4	-6
+50	-5	-4	-4	-7	-9	-5	-8	-9	-5	-6	-5	-7	-10	-12	-15	-11	-5	-9	-7	-6	-7	-2	-1	0
+40	0	+4	+1	-3	-5	-4	-8	-9	-6	-5	-7	-7	-6	-6	-7	-7	-4	-7	-7	-11	-3	+6	+6	+3
+30	+6	+6	+5	-2	-7	-8	-8	-7	-7	-4	-7	-10	-9	-7	-4	-3	+2	0	-8	-16	-6	+2	+7	+5
+20	+9	+7	+4	+1	-4	-10	-7	-1	-2	-4	-7	-10	-11	-9	-2	+2	+1	+1	-1	-6	-7	-4	+1	+6
+10	-2	-3	0	+4	+7	+2	-1	+1	-1	-3	-7	-10	-11	-10	-3	+1	-5	-4	-4	+1	+3	-10	-9	-1
0	-1	-2	+1	+5	+7	+4	+1	-1	0	-2	-6	-5	-12	-9	-3	-2	-3	-4	-2	+1	+4	-7	-6	-2
-10	+5	+3	+3	+6	+5	0	-3	-2	0	-1	-1	-2	-9	-8	-4	-2	-4	-5	-6	0	+1	-3	+1	+5
-20	+9	+4	0	0	+1	-1	+2	+1	-1	-4	-9	-9	-10	-7	-5	-1	-2	-5	-5	+1	-1	-2	+2	+8
-30	+4	-1	-6	-8	-8	-7	-3	+1	-2	-7	-6	-6	-6	-6	-2	+1	+3	+3	0	-3	-1	-1	+3	+6
-40	+3	-1	-7	-10	-9	-9	-5	-6	-11	-11	-3	-2	+1	-2	+2	+4	+3	+4	+1	-2	-1	+1	+4	+6
-50	+6	+3	-1	-5	-4	-4	-4	-9	-15	-16	-10	-2	+2	+3	+4	+6	+6	+3	+2	0	0	+4	+5	+5
-60	+11	+12	+8	+6	+6	+6	+6	+7	+4	-1	-3	-1	+1	+1	-2	-2	-4	-3	-2	-2	0	+6	+10	+11
-70	+16	+15	+13	+11	+10	+13	+7	+8	+14	+20	-4	-4	0	-5	-7	-6	-7	-5	-1	+4	+7	+12	+14	+15
-80	+10	+8	+12	+9	+8	+9	+8	+10	+5	+8	+6	+8	+10	+7	+3	+4	+1	+2	+4	+1	+3	+7	+8	+10

TABLE (34) for $\Delta i_r = \frac{\cos i}{\sin i} \cdot \Delta \gamma$

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$\lambda =$ / φ	0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	180°	195°	210°	225°	240°	255°	270°	285°	300°	315°	330°	345°
+80°	-0,4	-0,5	-0,6	-0,6	-0,5	-0,5	-0,2	-0,1	-0,6	-0,5	-0,6	-0,5	-0,2	-0,7	-0,6	-0,2	+0,2	+0,3	+0,3	+0,3	+0,3	+0,3	-0,1	-0,2	-0,1
+70	-0,5	-0,5	-0,6	-0,6	-0,6	-0,6	-0,1	-0,1	-0,7	-0,7	-0,6	-0,6	-0,6	-0,6	-0,2	-0,2	-0,1	-0,1	-0,1	+0,0	0,0	-0,2	-0,1	-0,2	-0,2
+60	-0,6	-0,6	-0,6	-0,6	-0,6	-0,6	-0,5	-0,5	-0,6	-0,6	-0,6	-0,6	-0,6	-0,6	-0,6	-0,6	-0,2	-0,2	-0,2	-0,2	-0,2	-0,2	-0,2	-0,2	-0,2
+50	-0,3	-0,3	-0,3	-0,3	-0,3	-0,3	-0,3	-0,3	-0,3	-0,3	-0,3	-0,3	-0,3	-0,3	-0,3	-0,3	-0,3	-0,3	-0,4	-0,4	-0,4	-0,4	-0,4	-0,4	-0,4
+40	-0,3	-0,3	-0,2	-0,2	-0,2	-0,2	-0,2	-0,2	-0,2	-0,2	-0,2	-0,2	-0,2	-0,2	-0,2	-0,3	-0,3	-0,3	-0,3	-0,3	-0,3	-0,3	-0,3	-0,3	-0,3
+30	-0,1	-0,1	-0,1	-0,1	-0,1	-0,1	-0,1	-0,1	-0,1	-0,1	-0,1	-0,1	-0,1	-0,1	-0,1	-0,1	-0,1	-0,1	-0,1	-0,1	-0,1	-0,1	-0,1	-0,1	-0,1
+20	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
+10	+0,2	+0,2	+0,2	+0,2	+0,1	+0,1	+0,1	+0,1	+0,1	+0,1	+0,1	+0,1	+0,2	+0,2	+0,2	+0,1	+0,1	+0,1	+0,1	+0,2	+0,2	+0,2	+0,2	+0,2	+0,2
0	+0,2	+0,2	+0,2	+0,2	+0,2	+0,2	+0,2	+0,2	+0,2	+0,2	+0,2	+0,2	+0,2	+0,2	+0,2	+0,2	+0,2	+0,2	+0,2	+0,2	+0,2	+0,2	+0,2	+0,2	+0,2
-10	+0,2	+0,2	+0,2	+0,2	+0,2	+0,2	+0,2	+0,2	+0,2	+0,2	+0,2	+0,2	+0,2	+0,2	+0,2	+0,2	+0,2	+0,2	+0,2	+0,2	+0,2	+0,2	+0,2	+0,2	+0,2
-20	+0,3	+0,3	+0,3	+0,3	+0,3	+0,3	+0,3	+0,3	+0,3	+0,3	+0,3	+0,3	+0,3	+0,3	+0,3	+0,3	+0,3	+0,3	+0,3	+0,3	+0,3	+0,3	+0,3	+0,3	+0,3
-30	+0,4	+0,4	+0,4	+0,4	+0,4	+0,4	+0,4	+0,4	+0,4	+0,4	+0,4	+0,4	+0,4	+0,4	+0,4	+0,4	+0,4	+0,4	+0,4	+0,4	+0,4	+0,4	+0,4	+0,4	+0,4
-40	+0,6	+0,6	+0,7	+0,7	+0,7	+0,7	+0,7	+0,7	+0,7	+0,7	+0,7	+0,7	+0,7	+0,7	+0,7	+0,7	+0,7	+0,7	+0,7	+0,7	+0,7	+0,7	+0,7	+0,7	+0,7
-50	+0,3	+0,3	+0,3	+0,4	+0,4	+0,4	+0,4	+0,4	+0,4	+0,4	+0,4	+0,4	+0,3	+0,3	+0,3	+0,2	+0,2	+0,2	+0,2	+0,3	+0,3	+0,3	+0,3	+0,3	+0,3
-60	-0,4	-0,4	-0,4	-0,4	-0,4	-0,4	-0,5	-0,6	-0,8	-1,1	-0,9	-0,7	-0,6	-0,5	-0,5	-0,4	-0,4	-0,4	-0,3	-0,3	-0,3	-0,3	-0,3	-0,4	-0,4
-70	-1,0	-1,1	-1,1	-1,0	-1,0	-1,0	-0,9	-0,9	-1,2	-1,5	-1,3	-1,1	-1,3	-1,5	-1,6	-1,3	-1,1	-1,0	-0,9	-0,9	-0,8	-0,9	-0,9	-1,0	-1,0
-80	-1,1	-1,1	-1,0	-0,9	-0,8	-0,5	-0,2	+0,2	+1,0	+1,3	+1,0	+0,4	+0,2	+1,0	0,0	-0,3	-0,6	-0,7	-0,8	-0,9	-1,0	-1,0	-1,0	-1,1	-1,1

TABLE (35) for $\Delta i_r = -\frac{\sin i \cos i}{\sin \varphi} \cdot \frac{\Delta \gamma}{\gamma}$

$\lambda =$ / φ	0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	180°	195°	210°	225°	240°	255°	270°	285°	300°	315°	330°	345°
+80°	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	-0,1	-0,1	-0,1	0,0	0,0	0,0	+0,1	+0,1	+0,1	+0,1	0,0
+70	+0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	-0,1	-0,1	-0,1	-0,1	-0,1	-0,1	+0,1	+0,1	+0,1	+0,1	+0,1
+60	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	-0,1	-0,1	-0,1	-0,1	0,0	+0,1	+0,1	+0,1	+0,1	+0,1
+50	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	+0,1	+0,1	+0,1	+0,1
-20	+0,1	+0,1	+0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
-30	+0,1	+0,1	+0,1	+0,1	+0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	+0,1
-40	+0,2	+0,2	+0,2	+0,2	+0,1	+0,1	+0,1	+0,1	0,0	0,0	0,0	-0,1	-0,1	-0,1	-0,1	-0,1	-0,1	-0,1	-0,1	-0,1	-0,1	0,0	+0,1	+0,1
-50	+0,1	+0,1	+0,1	+0,1	+0,1	+0,1	+0,1	+0,1	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0	0,0
-60	-0,1	-0,1	-0,1	-0,1	-0,1	-0,1	-0,1	-0,1	0,0	0,0	0,0	0,0	0,0	+0,1	0,0	+0,1	+0,1	+0,1	+0,1	+0,1	+0,1	0,0	0,0	0,0
-70	-0,1	-0,2	-0,2	-0,1	-0,1	-0,1	-0,1	-0,1	-0,1	-0,1	0,0	+0,2	+0,2	+0,2	+0,2	+0,2	+0,2	+0,2	+0,2	+0,2	+0,1	+0,1	0,0	-0,1
-80	-0,1	-0,1	-0,2	-0,2	-0,2	-0,1	-0,1	-0,1	-0,1	-0,1	-0,1	+0,1	+0,2	+0,2	+0,2	+0,3	+0,3	+0,3	+0,3	+0,3	+0,2	+0,2	0,0	0,0

For all latitudes between +50 and -20°, Δi_r & 0.

TABLE (26) for $\Delta \tau_r = \sin i \Delta \gamma$ in Gaussian units of the second decimal place

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$\lambda =$ / φ	0°	15°	30°	45°	60°	75°	90°	105°	120°	135°	150°	165°	180°	195°	210°	225°	240°	255°	270°	285°	300°	315°	330°	345°
+80°	0	0	0	0	0	0	0	0	0	0	0	0	0	+1	+1	+1	0	0	0	-1	-1	-1	-1	0
+70	0	0	0	0	0	0	0	0	0	0	0	0	0	+1	+1	+1	+1	+1	+1	-1	-1	-1	-1	-1
+60	0	0	0	0	0	0	0	0	0	0	0	0	0	0	+1	+1	+1	+1	0	-1	-1	-1	-1	-1
+50	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	-1	-1	-1	0
-20	+1	+1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-30	+1	+1	+1	+1	+1	+1	0	0	0	0	0	0	0	0	0	0	0	0	-1	-1	-1	0	0	+1
-40	+1	+1	+1	+1	+1	+1	+1	+1	0	0	0	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	0	0	+1
-50	+1	+1	+1	+1	+1	+1	+1	+1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
-60	-1	-1	-1	-1	-1	-1	-1	-1	-1	0	0	0	+1	+1	+1	+1	+1	+1	+1	+1	+1	0	0	0
-70	-1	-2	-2	-3	-3	-3	-4	-4	-4	-3	0	+2	+3	+3	+3	+3	+3	+3	+2	+2	+1	+1	0	-1
-80	-1	-2	-3	-3	-3	-3	-3	-3	-3	-3	-1	+1	+3	+3	+3	+1	+3	+3	+3	+2	+2	+1	0	0

For the latitudes between +50° and -20° $\Delta \tau_r$ & 0

Since only the western component Y changes on the average of all values of Table $(6)_\alpha$ by $\Delta y = 0.017$, but the forces X and Z remain the same, then if τ signifies the entire intensity, $\tau\Delta\tau = \tau\Delta\tau = y\Delta y$, due to $X^2 + Y^2 = \tau^2$, and $Z^2 + \tau^2 = \tau^2$, and since on the average for the entire terrestrial surface $Y = 0.5$, $\tau = 5.0$, and $\tau = 2$, it follows on the average that $\Delta Y/Y = 1/30$, while $\Delta\tau = (1/10) .Y$, $\frac{\Delta\tau}{\tau} = 1/3000$, and furthermore $\Delta\tau = 1/4\Delta Y$ and $\frac{\Delta\tau}{\tau} = 1/500$. The influence of possible electrical currents on Y and on the declination is still perceptible. On the entire intensity τ it is, however, almost zero; likewise, it is very small with respect to $\mathcal{T}$ and i, as can be seen from the immediately following tables (34), (35) and (36), which are computed with the help of formulas (33) and Table $(6)_\alpha$. Finally, it should also be noted that

table $(30)_\alpha$ is obtained by summation of tables (30) and (34)
table $(31)_\alpha$ " " " " " " (31) and (35)
table $(32)_\alpha$ " " " " " " (32) and (36)

By putting in the corrections $\Delta\delta_r$, Δi_r and $\Delta\tau_r$ due to l_o into the differences $\delta_r - \delta_b$, $i_r - i_b$ and $\tau_r - \tau_b$ of Tables (30), (31) and (32), $\delta_r - \delta_b$ fall from ±41.4' to ±38.6' accordingly on the average for the locations between the latitudes +50° and -50°, and $i_r - i_b$ falls from ±41.2' to 40.6' on the average for the entire terrestrial surface, and likewise $\tau_r - \tau_b$ falls from ±0.054 to ±0.053 on the average for all values of table (32). Hence, through the assumption of vertical electrical currents the agreement between theory and observation is increased very little.

The small amounts of the corrections $\Delta\delta_r$, Δi_r and $\Delta\tau_r$, computed according to formulas (33) with the help of table $(6)_\alpha$, are compiled in Tables (34), (35) and (36).

II. HOW THE THREE TERRESTRIAL MAGNETIC ELEMENTS ARE RELATED TO EACH OTHER

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At any point of space the effect of the Earth's magnetism is determined by three mutually independent quantities which specify the direction of the needle (δ, i) and the force acting upon it (τ or T).

However, if we consider the magnetic elements at locations, all of which lie on the surface of a sphere (the Earth), then not all three, but only two, can be independent of each other, and consequently, there must exist a relationship between them since all are phenomena on a spherical surface, varying with the location, which depend on two mutually independent variables, as which longitude and latitude usually serve. The same holds also if the Earth is regarded as a rotational ellipsoid.

Hence, if δ and T are known for a large part of the Earth's surface, we can compute the inclination, i, and if i and T are given for the greater part of the Earth's surface, we can find the declination, δ, for the entire surface of the Earth. This is evident, e.g., in our above numerical equations $(X)_0$, $(Y)_0$, $(Z)_0$, $(X)_1$, $(Y)_1$, $(Z)_1$, $(X)_2$, $(Y)_2$, $(Z)_2$,...from which we have computed the coefficients g, h of the theory, while X and Y are found with the help of the two quantities δ and T, and Z is obtained from i and T. From X alone, as well as from Y alone, we could have derived all 63 values, g,h. Also by means of Y, we can find all coefficients g, h except for the 7 unknowns $g_1^0, g_1^1, g_2^0, g_2^1, h_2^1, g_3^0, g_3^1$. For a complete knowledge of all the effects of terrestrial magnetism on and outside of the Earth's surface, it is not the case, as Gauss asserts in paragraph 20 of his work, that knowledge of X or i_r for the entire terrestrial surface is necessary, but rather so many values of X or Z, that the coefficients of the theory according to the equations $(X)_0$, $(Y)_0$, $(Z)_0$, $(X)_1$, $(Y)_1$, $(Z)_1$, $(X)_2$, $(Y)_2$, $(Z)_2$,...etc., can be completely calculated.

In his "General Theory of the Earth's Magnetism", paragraph 15, page 139, Gauss has given the relationship between X and Y the form /63

$$Y = \frac{1}{\sin u}\int \frac{dX}{d\lambda}\,du$$

Now, we can set up yet another relationship between the derivatives $\frac{dT}{d\lambda}$, $\frac{d\delta}{d\lambda}$, $\frac{dT}{du}$ and $\frac{d\delta}{du}$ or also between $\frac{dx}{d\lambda}$, $\frac{dy}{d\lambda}$, $\frac{dz}{d\lambda}$, $\frac{dx}{du}$, $\frac{dy}{du}$ and $\frac{dz}{du}$ in which, as before, J signifies the entire intensity. According to Gauss (cf. his works, page 142), $X = -\frac{dV}{r\,du}$ and $Y = -\frac{dV}{r\sin u\,d\lambda}$ hence from equation (1), $\frac{dX}{d\lambda} = -\frac{d\,dV}{r\,du\,d\lambda}$ and from equation (2) $\frac{dV}{r\,d\lambda} = -Y\sin u$ On substituting equation (2) into equation (1), we obtain equation (3) $\frac{dX}{d\lambda} = \frac{d(Y\sin u)}{du} = \sin u\frac{dY}{du} + Y\cos u$.

But $X = T\cos\delta$ and $Y = T\sin\delta$, and therefore $\frac{dY}{du} = \sin\delta\frac{dT}{du} + T\cos\delta\frac{d\delta}{du}$ and $\frac{dX}{d\lambda} = \cos\delta\frac{dT}{d\lambda} - T\sin\delta\frac{d\delta}{d\lambda}$ so that we have from equation (3), if by dT we understand the variation of T for $d\lambda = 1'$ and $du = 1'$, equation (4)

$$\cos\delta\frac{dT}{d\lambda\sin 1'} - T\sin\delta\frac{d\delta}{d\lambda} = \sin u\sin\delta\frac{dT}{du\sin 1'} + T\sin u\cos\delta\frac{d\delta}{du} + T\sin\delta\cos u$$

hence also since $T = J\cos i$, and therefore $\frac{dT}{d\lambda} = \cos i\frac{dJ}{d\lambda} - J\sin i\frac{di}{d\lambda}$ and $\frac{dT}{du} = \cos i\frac{dJ}{du} - J\sin i\frac{di}{du}$. Thus we have Equation (5)

$$\cos\delta\cos i\frac{dJ}{d\lambda\sin 1'} - J\cos\delta\sin i\frac{di}{d\lambda} - J\cos i\sin\delta\frac{d\delta}{d\lambda} = \sin u\sin\delta\cos i\frac{dJ}{du\sin 1'} - J\sin u\sin\delta\sin i\frac{di}{du} + J\cos i\sin u\cos\delta\frac{d\delta}{du} + J\cos i\sin\delta\cos u,$$

where dJ signifies the change in J for $d\lambda = 1'$ and $du = 1'$, respectively.

Strictly speaking, eauations (4) and (5), as well as the equation $Y = \frac{1}{\sin u}\int \frac{dX}{d\lambda}\,du$ hold only for terrestrial magnetic elements, which are calculated according to the Gaussian theory, since they rest on the assumption that all locations lie on one spherical surface; for anomalous regions of the Earth's surface--which must be considered as including the entire surface of the Earth--these equations do not rigorously hold which has also proved to be the case, e.g., from my observations within the Moscow magnetic anamoly.

Other than the above mentioned relationships between the magnetic elements, which rest on a theoretical basis, none exist; /64
however, simple empirical formulas between them can be set up as I have earlier done in part.

In 1895, I published a treatise entitled "On the Relationship Between the Terrestrial Magnetic Horizontal Intensity and the Inclination, with a supplement of 25 tables, 42 pages, Saint Petersburg",[1] in which I specified simple equations, according to which we can calculate the terrestrial magnetic horizontal intensity T_r from the known (observed) inclination i_b and conversely, the inclination i_r from the given horizontal intensity T_t . These formulas are so constituted that the longitude, ϕ, (east of Greenwich), and the latitude, λ, of the location to which the intensity, T and the inclination, i, belong, exert only a slight influence on the quantities to be found, T_r or i_r. These formulas read:

Formula (6): $tg(i-\alpha)=u(0{,}592-lgT)$, usable for the terrestrial surface from latitude +90° to +45°.

Formula (7): $tg(i-\alpha_3)=u_3(0{,}592-lgT)$, usable from latitude -90° to latitude -45°

$$\alpha = 5^\circ + 0{,}000000015\,85\,u^6 \qquad \alpha_3 = 5^\circ - 0{,}00\,1025\,u_3^2$$

Formula (11): $$u = 6{,}245 + 0{,}00394\,u^{\frac{1}{2}}\sin(139^\circ{,}9\,u^{\frac{3}{2}}+\lambda) + 0{,}000504\,u^{\frac{3}{2}}\sin(118^\circ{,}5\,u^{\frac{3}{2}}+2\lambda)$$

Formula (19) $$u_3 = 6{,}427(5^\circ+u_3)^{\frac{1}{2}} + 0{,}01106\,u_3^{\frac{1}{2}}\sin(113^\circ{,}0\,u_3^{\frac{3}{2}}+\lambda) + 0{,}00244\,u_3^{\frac{1}{2}}\sin(188^\circ{,}3\,u_3^{\frac{1}{2}}+2\lambda) + 0{,}00162\,u_3^{\frac{3}{2}}\sin(146^\circ{,}0\,u_3^{\frac{3}{2}}+3\lambda)$$

u signifies the angular distance of the location to which T and i belong from the astronomical North Pole, so that $u_3 = 90^\circ - \phi$, since ϕ denotes that the geographical latitude and u_3 is the

[1] In the sequel I shall, for the sake of brevity, designate this treatise as "Treatise 1895".

angular distance of the observational location from the astronomical South Pole so that $u_3 = 90° - \phi$, if the southern latitude, ϕ, is not taken as a negative, but as a positive number in the calculation; u and u_3 are to be expressed in degrees and their decimal fractions.

In formulas (16) and (19), the fractions 7/6, 1/20, 2/9, 7/5, etc., which stand to the right of u and u_3, are exponents of u, $5 + u_3$ and u_3.

Moreover, in Treatise 1895, I have established the following formulas for the terrestrial surface, lying on both sides of the Equator between latitudes +50° and -30°.

Formula (20): $i = c\,T^{\frac{7}{6}}/(t_g i)^{\frac{1}{6}}$ or $T = \left(\frac{i}{c}\right)^{\frac{6}{7}} \cot g\, i$, if i is numerically greater than 35°.

Formula (37): $T = \left(\frac{i}{c}\right)^{\frac{6}{7}} \cot g\, i + \left(\frac{u_3 + 5}{u_3 + 1}\right)^{\frac{1}{7}}$; if i is numerically smaller than 35°, the term $\left(\frac{u_3+5}{u_3+1}\right)^{\frac{1}{7}}$ is appreciable, while for i greater than 35°, it vanishes.

Formula (22), valid for latitudes, ϕ, between 0° and -50°:

$$c = 16{,}31 - 0{,}0005(25° - \varphi)^2 + [0{,}20 + 0{,}0015(25° - \varphi)^2] \sin[48° + 0{,}033(27° - \varphi)^2 + \lambda] + [1{,}40 - 0{,}001(25° - \varphi)^2] \sin[26° + 0{,}132\,\varphi + 2\lambda]$$

Formula (23), valid for latitudes, ϕ, between 0° and -60°: /65

$$c = 17{,}47 - 0{,}002(27° - \varphi)^2 + [3{,}40 - 0{,}00228(32° - \varphi)^2] \sin[100° - 0{,}01833(24° - \varphi)^2 + \lambda] + [0{,}52 - 0{,}00026(57° - \varphi)^2] \sin[5° + 0{,}0285(43 - \varphi)^2 + 2\lambda]$$

In formulas (22) and (23) ϕ is to be expressed in degrees and decimal fractions of degrees and is to be taken as positive, so that e.g., in (23) for the southern latitude -40°, the expression 27°-ϕ is not equal to 67°, but equals -13°. To facilitate the computation

of i from T and conversely, the coefficients a, a_3 and c of the above formulas hold for the middle of the 19th Century since they are derived with the help of the observations of terrestrial magnetism (valid for 1830) assembled by Gauss in his Atlas, and the observations assembled by Sabine (valid for 1842) and the magnetic charts published by Neumayer (valid for 1885). Both a and a_3 have declined on the average by only 0.27 from 1836 to 1855, and c has increased by nearly the same amount. Also from the comparison of our formulas with individual observations at different times between 1812 and 1893 (cf. the supplement of the Treatise 1885, tables (45)-(51)) it is easy to see that a, a_3 and b change very little. Formulas (6) and (7) have been found on the basis of the great similarity of the isoclines with the lines of equal horizontal intensity, T, near the magnetic poles, and formula (37) rests on the basis of the parallelism of the isoclines and the lines of equal horizontal intensity, $Z = T \operatorname{tg} i$. In (6), (7) and (37) λ and ϕ, have little influence on the value of the magnetic elements sought, as already noted (cf. tables for a, a_3 and c in the supplement of Treatise 1895). There are still other equations between the three elements the declination δ, the inclination, i, and the horizontal intensity T, in which as variables besides δ, i, T, the geographic longitude λ (east of Greenwich), the latitude, ϕ, on the contrary do not appear at all. In order to obtain them, I have first of all used only the charts of Prof. Neumayer which are valid for 1885. With the help of those lines of equal inclination and equal horizontal intensity which extend through all longitudes, λ, from 0° to 360°, I determined the corresponding values of i, T, δ, by obtaining first the latitude, ϕ, at which the isoclines or lines of equal T, respectively, intersect the meridians λ = 0°, 20°, 40°, etc., and then I took λ, ϕ for the location from the other charts according to δ, i, T. Thus I obtained the following table:

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TABLE (38)

TABLE (38) continued

TABLE (39)

TABLE (39) continued

	λ =	0°	20°	40°	60°	80°	100°	120°	140°	160°	180°	200°	220°	240°	260°	280°	300°	320°	340°
isocline i = -45°	φ	-36,5	-32,2	-27,0	-22,0	-14,0	-4,0	-7,5	-12,0	-21,0	-49,2	-24,3	-23,0	-28,7	-33,0	-40,2	-43,3	-42,0	-41,0
	δ	+28,1	+24,0	+18,2	+4,7	+3,7	+1,2	-1,1	-4,9	-9,2	-10,6	-2,8	-2,1	-18,8	-45,4	-19,8	-14,1	-1,0	+14,2
	T	2,14	2,34	2,61	2,80	3,01	3,23	3,43	3,53	3,46	3,32	3,21	3,09	2,98	2,87	2,83	2,78	2,59	2,39
isocline i = -60°	φ	-52,5	-43,3	-33,3	-24,5	-16,9	-12,7	-11,0	-13,5	-32,2	-34,5	-40,0	-42,4	-42,0	-50,0	-52,0	-45,0	-42,2	-45,0
	δ	+22,4	+32,1	+23,8	+14,6	+10,7	+6,1	+0,7	-5,5	-11,3	-13,5	-12,7	-12,8	-15,6	-22,8	-22,0	-20,0	-8,0	+6,5
	T	2,04	1,89	2,05	2,20	2,37	2,52	2,81	2,94	2,89	2,72	2,67	2,60	2,56	2,62	2,66	2,54	2,36	2,23
isocline i = -30°	φ	-75,8	-71,1	-60,5	-48,0	-43,0	-40,0	-40,0	-40,8	-44,0	-49,3	-53,0	-55,5	-58,2	-64,5	-78,2	-76,5	-72,7	-72,7
	δ	+14,0	+27,0	+37,0	+34,5	+26,7	+18,8	+5,2	-5,8	-14,1	-17,5	-16,6	-17,5	-22,6	-31,5	-33,5	-23,0	-10,0	+2,0
	T	1,82	1,73	1,63	1,67	1,79	1,91	2,08	2,18	2,09	2,04	2,04	2,08	2,14	2,23	2,11	1,98	1,93	1,87
isocline i = -15°	φ	-83,6	-81,9	-77,2	-68,1	-55,8	-49,0	-45,4	-46,5	-54,0	-58,0	-59,2	-64,9	-64,6	-74,2	-80,0	-85,7	-83,6	-84,0
	δ	+14,0	+24,0	+36,5	+46,0	+43,5	+28,0	+8,8	-5,5	-16,2	-19,8	-19,3	-23,4	-29,0	-43,0	-35,5	-24,0	-11,0	+4,5
	T	1,53	1,51	1,47	1,40	1,41	1,57	1,75	1,82	1,68	1,63	1,70	1,74	1,80	1,73	1,70	1,60	1,61	1,54
isocline i = -7,5°	φ	-88,2	-87,8	-86,4	-83,5	-78,0	-58,4	-54,8	-52,5	-57,6	-62,0	-63,9	-68,0	-78,2	-83,4	-86,7	-87,9	-88,2	-88,7
	δ	+14,0	+24,0	+38,0	+48,0	+43,0	+39,0	+14,5	-4,6	-18,5	-24,5	-24,0	-29,0	-46,0	-58,0	-36,0	-25,0	-12,0	0,0
	T	1,23	1,24	1,25	1,23	1,17	1,21	1,34	1,35	1,29	1,23	1,23	1,22	1,24	1,28	1,26	1,25	1,25	1,25

TABLE(40) All values of φ and i in this table are positive. Northern hemisphere

	λ =	0°	20°	40°	60°	80°	100°	120°	140°	160°	180°	200°	220°	240°	260°	280°	300°	320°	340°
T = 3,0	φ	+13,3	+24,5	+33,7	+36,5	+37,3	+37,2	+37,0	+35,3	+30,2	+25,3	+23,5	+24,3	+28,7	+28,0	+25,2	+17,3	+10,0	+10,0
	i	+25,2	+35,0	+44,4	+50,0	+52,0	+54,7	+53,4	+48,8	+40,4	+38,0	+40,9	+47,6	+53,0	+53,8	+55,8	+49,2	+40,0	+30,8
T = 2,8	φ	26,0	33,0	37,2	38,7	40,2	40,9	40,6	40,3	37,9	31,8	30,0	32,0	32,9	31,0	29,7	23,0	17,8	19,0
	i	42,2	46,0	49,9	53,9	56,5	57,8	57,6	54,5	49,7	45,8	48,7	53,8	58,0	60,0	60,6	55,3	50,0	43,3
T = 2,6	φ	32,3	37,3	40,8	43,2	44,0	44,1	44,4	44,8	43,8	38,6	36,2	37,4	34,5	34,2	31,2	27,3	23,1	25,8
	i	51,0	51,5	54,3	57,8	59,7	61,3	61,6	59,2	55,3	52,5	54,5	58,3	64,4	63,8	64,4	60,4	55,2	51,0
T = 2,2	φ	38,2	41,8	43,6	45,8	47,8	48,7	50,2	52,0	53,0	52,7	50,2	47,5	43,2	38,8	37,1	33,8	32,0	34,0
	i	60,6	60,3	62,3	64,2	66,0	67,0	67,0	66,5	64,6	64,8	65,5	66,7	68,0	68,7	69,1	66,4	63,0	60,6
T = 1,8	φ	54,5	54,8	57,2	57,3	56,0	55,3	56,5	58,2	59,4	59,4	58,1	56,5	52,0	44,7	42,0	40,1	40,7	44,0
	i	68,0	67,6	68,2	70,9	71,2	71,7	72,0	71,3	70,0	70,8	71,3	72,3	72,6	73,5	73,4	71,2	69,0	67,5
T = 1,4	φ	63,0	64,8	65,5	65,3	64,0	63,0	63,3	64,4	66,0	66,4	64,8	60,6	55,2	49,7	47,0	48,2	52,7	58,6
	i	73,6	73,5	74,0	75,7	76,3	76,8	76,3	75,8	75,8	75,9	76,5	76,8	77,2	77,6	77,5	76,2	75,0	73,9

TABLE (40) continued

	λ =	0°	20°	40°	60°	80°	100°	120°	140°	160°	180°	200°	220°	240°	260°	280°	300°	320°	340°
$T=1,0$	φ	75,7	78,6	74,9	73,0	70,1	69,3	69,3	70,2	74,5	76,8	70,6	67,0	64,0	58,6	57,6	72,5	68,0	74,0
	i	79,9	78,1	78,5	79,0	80,1	80,2	80,2	79,2	80,0	80,2	80,5	80,3	81,0	81,2	81,2	80,5	79,7	79,8
$T=0,6$	φ	83,0	84,8	84,2	82,8	80,0	77,1	76,4	76,5	76,9	77,1	76,2	73,7	68,0	60,2	52,8	78,6	82,8	84,5
	i	83,4	83,3	83,2	83,1	83,1	83,1	83,4	83,3	83,2	83,5	83,8	83,2	84,4	84,5	83,8	83,1	83,7	83,4

TABLE (41) southern magnetic hemisphere

	λ =	0°	20°	40°	60°	80°	100°	120°	140°	160°	180°	200°	220°	240°	260°	280°	300°	320°	340°
$T=3,0$	φ	+0,3	0,0	-2,6	-7,7	-14,2	-20,2	-25,1	-28,0	-29,8	-31,3	-32,0	-30,0	-27,8	-25,2	-18,0	-9,6	+2,7	+2,0
	i	-24	-21,6	-29,7	-37,6	-45,7	-54,3	-56,5	-58,5	-57,0	-54,8	-52,2	-48,8	-44,0	-35,1	-16,6	+15,3	+29,0	+45,5
$T=2,8$	φ	-4,0	-4,0	-7,5	-12,0	-18,3	-23,5	-28,5	-31,7	-32,8	-35,3	-34,8	-34,5	-33,7	-38,6	-39,7	-53,7	-9,8	-7,2
	i	-17,7	-32,3	-38,7	-45,0	-51,0	-55,2	-60,3	-62,0	-60,2	-58,7	-56,7	-55,0	-52,2	-50,9	-54,7	-48,4	+9,8	+1,0
$T=2,6$	φ	-11,6	-10,3	-12,2	-14,8	-22,3	-27,2	-31,8	-34,0	-36,0	-38,9	-44,8	-42,3	-43,5	-51,2	-44,0	-63,5	-56,0	-14,0
	i	-25,0	-32,8	-45,3	-57,2	-55,5	-59,8	-63,5	-64,3	-63,8	-62,2	-61,1	-60,0	-58,8	-60,8	-61,7	-58,3	-47,3	-9,3
$T=2,2$	φ	-28,8	-23,0	-23,2	-27,0	-31,4	-35,0	-38,0	-39,8	-44,0	-44,1	-50,8	-52,2	-56,8	-64,5	-70,0	-71,8	-74,1	-64,5
	i	-43,1	-49,7	-56,0	-60,6	-63,5	-65,8	-68,4	-69,6	-68,5	-68,0	-67,5	-67,3	-62,9	-78,0	-68,2	-66,0	-64,0	-60,9
$T=1,8$	φ	-76,4	-62,7	-48,7	-41,2	-42,5	-43,9	-44,5	-45,8	-49,2	-53,7	-57,4	-61,8	-66,6	-73,6	-78,2	-79,7	-80,0	-79,8
	i	-78,6	-66,3	-65,8	-67,5	-70,0	-72,0	-74,5	-75,0	-74,0	-73,2	-73,2	-72,6	-74,9	-76,5	-73,5	-72,5	-72,8	-71,1
$T=1,4$	φ	-85,5	-84,8	-81,1	-69,1	-56,0	-52,5	-50,8	-51,1	-55,2	-60,0	-64,5	-69,1	-75,5	-81,5	-84,4	-85,7	-86,0	-86,0
	i	-76,5	-76,6	-76,1	-75,2	-75,2	-76,7	-78,1	-78,2	-77,3	-77,2	-78,5	-79,0	-78,6	-77,5	-77,2	-76,5	-76,7	-76,1
$T=1,2$	φ	-89,1	-88,7	-88,4	-85,0	-67,0	-56,7	-53,6	-54,4	-58,2	-63,0	-67,5	-72,0	-86,8	-87,0	-88,7	-89,1	-89,2	-89,2
	i	-79,2	-78,5	-79,1	-78,6	-78,1	-78,7	-79,5	-79,6	-79,3	-79,8	-80,8	-81,2	-79,9	-79,2	-79,8	-79,1	-79,2	-79,3

A. The declination δ represented as a function of the longitude λ and the inclination, i. With the help of Table (38) I have computed the equations (42) in accordance with the formula $\delta = a + a' \sin(\lambda' + \lambda) + a'' \sin(\lambda'' + 2\lambda) + \dots$

i	a	a'	λ'	a''	λ''	a'''	λ'''	a^{IV}	λ^{IV}	i
0°	+0,1	+10,1	78,7	+5,7	180,1	+4,6	123,5	+2,0	202,5	0°
+15	+0,2	+9,4	81,6	+5,4	182,2	+4,2	119,9	+1,8	205,9	+15
+30	+0,1	+9,2	82,5	+5,4	184,2	+3,6	112,5	+1,7	210,6	+30
+45	-0,2	+9,4	80,9	+6,2	141,7	+3,0	98,1	+1,5	226,8	+45
+60	-0,6	+11,1	85,0	+11,4	155,5	+2,7	79,6	+1,7	250,0	+60
+70	-0,7	+14,4	92,9	+14,8	160,2	+1,7	79,5	+1,5	253,1	+70
+75	-1,0	+18,4	103,1	+20,-	162,3	+1,0	154,7	+1,8	273,2	+75
+80	-2,5	+27,8	109,6	+25,5	165,7	+3,2	143,5	+3,3	304,5	+80
+85	-8,2	+48,1	116,7	+34,3	172,7	+15,4	130,3	+8,0	334,9	+85

Equation (42)

Since the vertical number row u, u', U', u'', U'', etc., must be functions of the inclination, i, we obtain: /69

Formula (43) for the northern magnetic hemisphere, in which i is positive

$$\delta = -(\underline{-13,52})\,i^{10} + (\underline{-73,48})\,i^{40} + \left[9{,}2 + (\underline{-14,03})\cdot i^{2,0133} + (\underline{-57,013})\,i^{30}\right]\sin\left[\text{[illegible]} + \lambda\right]$$
$$+\left[5{,}3 + (\underline{-4,20})\,i^{4,26}\right]\sin\left[100{,}3 + (\underline{-0,974})\,i + 2\lambda\right] + \left[4{,}8 - (\underline{-3,28})\,i^{2} + (\underline{-56,69})\,i^{30}\right]\sin\left[\text{[illegible]} + 3\lambda\right]$$
$$+\left[1{,}7 + (\underline{-42,45})\,i^{20}\right]\sin\left[198^\circ + (\underline{-4,874})\,i^{2} + (\underline{-32,08})\,i^{30} + \lambda\right]$$

The factors enclosed in parentheses and underscored involving powers of i are logarithms, in whose place the corresponding numbers should stand. This comment also holds for the immediately following formula (45).

With the values of the above table (39), I obtained the

Formula 44

i	u u' U' u'' U'' u''' U'''	i
-15°	$\delta = -0{,}1 + 11{,}1\sin(73{,}4 + \lambda) + 6{,}5\sin(93{,}0 + 2\lambda) + 5{,}0\sin(128{,}6 + 3\lambda)$	-15°
-30	$\delta = -0{,}5 + 12{,}6\sin(65{,}9 + \lambda) + 7{,}1\sin(84{,}5 + 2\lambda) + 5{,}4\sin(118{,}8 + 3\lambda)$	-30
-45	$\delta = -0{,}9 + 15{,}3\sin(55{,}0 + \lambda) + 8{,}1\sin(71{,}3 + 2\lambda) + 5{,}8\sin(106{,}3 + 3\lambda)$	-45
-60	$\delta = -1{,}8 + 21{,}3\sin(40{,}9 + \lambda) + 9{,}3\sin(48{,}9 + 2\lambda) + 4{,}5\sin(91{,}5 + 3\lambda)$	-60
-70	$\delta = -1{,}5 + 29{,}9\sin(31{,}8 + \lambda) + 9{,}0\sin(12{,}8 + 2\lambda) + 2{,}3\sin(168{,}9 + 3\lambda)$	-70
-75	$\delta = -1{,}3 + 36{,}8\sin(28{,}3 + \lambda) + 8{,}2\sin(-6{,}4 + 2\lambda) + 6{,}0\sin(152{,}2 + 3\lambda)$	-75
-78,5	$\delta = -1{,}8 + 44{,}3\sin(26{,}5 + \lambda) + 6{,}7\sin(-37{,}2 + 2\lambda) + 8{,}9\sin(201{,}7 + 3\lambda)$	-78,5

From this we obtain for the southern magnetic hemisphere the following formula; in this hemisphere the inclination i is negative.

Formulas (45) in which i is to be taken as a positive number.

$$\delta = -\tfrac{1}{6}\,i^{0,5} + \left[9{,}2 + (\underline{-3,326})\,i^{0,5} + (\underline{-27,44})\,i^{15}\right]\sin\left[80{,}3 - (\underline{-0,631})\,i^{4,5} + \lambda\right]$$
$$+\left[5{,}3 + \tfrac{1}{15}\,i - (\underline{-18,487})\,i^{10}\right]\sin\left[100{,}3 - (\underline{-1,01})\cdot i^{4,5} - (\underline{-13,33})\cdot i^{8} + 2\lambda\right]$$
$$+\left[4{,}8 - (\underline{-21,74})\cdot i^{12} + (\underline{-36,72})\cdot i^{20}\right]\sin\left[127^\circ - (\underline{-1,1431})\,i^{4,5} + (\underline{-16,74})\cdot i^{10} + 3\lambda\right]$$

To simplify computations with the formulas (43) and (45), I have constructed the two tables (46) and (47) which present u, u', U', u'', U'', etc. with the argument i. In Table (46) the following symbols have the indicated meaning in accordance with formula (43):

$u^{(\omega)} = 5{,}3 + \ldots i - (\ldots) i^{\ldots}$, $U^{(\omega)} = 100{,}3 - (\ldots) i^{\ldots} - (\ldots) i^{\ldots}$, $u^{(\rho)} = 4{,}8 - (\ldots) i^{\ldots} + (\ldots) i^{\ldots}$ [illegible]
$U^{(\rho)} = 127^{\circ} - (\ldots) i^{\ldots} + (\ldots) i^{\ldots}$ [illegible]

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TABLE (46) for formula (43)

i	u	u'''	U'''	$u^{(\omega)}$	$U^{(\omega)}$	$u^{(\rho)}$	$U^{(\rho)}$	$u^{(4)}$	$U^{(4)}$
0°	0,0	5,2	82,3	5,3	100,3	4,8	127°	1,3	198°
10	0,0	9,2	80,3	5,3	108,7	4,7	119	1,7	200
20	0,0	9,2	80,3	5,4	112,8	4,5	111	1,7	203
30	0,0	9,2	80,5	5,6	125,6	4,2	103	1,7	210
40	0,0	9,3	81,1	6,4	136,0	3,8	95	1,7	219
50	0,0	9,6	82,7	8,0	142,0	3,2	88	1,7	231
51	0,0	9,7	83,0	8,2	143,3	3,2	87	1,7	232
52	0,0	9,8	83,3	8,5	144,1	3,1	87	1,7	234
53	-0,1	9,9	83,6	8,8	145,0	3,0	86	1,7	235
54	-0,1	10,0	83,9	9,1	145,8	3,0	86	1,7	237
55	-0,1	10,1	84,3	9,4	146,7	2,9	85	1,7	238
56	-0,1	10,2	84,7	9,7	147,5	2,8	85	1,7	240
57	-0,1	10,3	85,1	10,0	148,4	2,8	85	1,7	241
58	-0,1	10,5	85,5	10,4	149,2	2,7	85	1,7	243
59	-0,2	10,7	86,0	10,8	150,0	2,6	85	1,7	244
60	-0,2	11,0	86,6	11,2	150,9	2,5	85	1,7	246
61	-0,2	11,2	87,1	11,6	151,7	2,4	85	1,7	247
62	-0,3	11,5	87,7	12,1	152,6	2,3	86	1,7	249
63	-0,3	11,8	88,3	12,6	153,4	2,2	87	1,7	251
64	-0,4	12,2	89,0	13,1	154,2	2,2	88	1,7	253
65	-0,4	12,6	89,8	13,7	155,1	2,1	89	1,7	254
66	-0,5	13,1	90,6	14,3	155,9	2,1	91	1,7	256
67	-0,6	13,6	91,4	14,9	156,8	2,0	93	1,7	258
68	-0,7	14,1	92,3	15,5	157,6	1,9	95	1,7	260
69	-0,8	14,7	93,2	16,1	158,5	1,8	98	1,7	262
70	-0,9	15,4	94,2	16,8	159,3	1,7	102	1,8	264
71	-1,0	16,2	95,3	17,5	160,2	1,7	107	1,8	266
72	-1,1	17,0	96,4	18,3	161,0	1,6	112	1,8	268
73	-1,3	18,0	97,6	19,0	161,9	1,7	118	1,9	270
74	-1,5	19,0	98,9	19,8	162,7	1,7	126	2,0	273
75	-1,7	20,3	100,3	20,7	163,5	1,7	134	2,0	276
76	-1,9	21,5	101,7	21,6	164,4	1,8	144	2,2	278
77	-2,2	23,0	103,3	22,5	165,2	2,0	155	2,2	281
78	-2,5	24,6	104,7	23,5	166,1	2,3	168	2,4	285
79	-2,8	26,4	106,9	24,5	166,9	2,8	182	2,8	289
80	-3,1	28,5	108,9	25,6	167,7	3,5	199	3,0	293
81	-3,5	30,9	110,1	26,7	168,6	4,6	218	3,5	297
82	-3,9	33,8	113,1	27,8	169,4	6,3	240	4,2	303
83	-4,2	37,2	114,2	29,0	170,3	8,6	264	5,2	309
84	-4,6	41,3	116,4	30,3	171,1	12,0	292	6,2	317
85	-4,8	46,0	118,6	31,5	172,0	16,9	324	7,8	326
86	-5,0	53,1	120,9	32,9	172,8	23,8	359	10,0	337
87	-4,9	59,6	123,4	34,3	173,7	33,5	46	12,6	350
88	-4,1	69,1	126,1	35,7	174,5	47,2	61	16,2	7
89	-2,7	81,7	128,9	37,2	175,4	66,2	126	21,0	26
90	0,0	96,7	131,8	38,8	176,2	92,2	192	27,1	40

TAB(47) for formula (45)

i	u	u'''	U'	$u^{(\omega)}$	$U^{(\omega)}$	$u^{(\rho)}$	$U^{(\omega)}$
0°	0,0	9,2	80,3	5,3	100,3	4,8	127°
-10	-0,5	9,4	74,1	6,0	92,2	4,8	125
-20	-0,7	10,0	70,4	6,6	84,6	4,8	121
-30	-0,9	11,5	63,9	7,3	84,2	4,8	115
-40	-1,1	14,0	56,8	8,0	75,3	4,8	109
-50	-1,2	17,6	49,2	8,6	63,9	4,8	104
-51	-1,2	18,0	48,5	8,6	62,6	4,8	104
-52	-1,2	18,4	47,7	8,7	61,2	4,8	103
-53	-1,2	18,8	46,9	8,8	59,7	4,7	103
-54	-1,2	19,3	46,1	8,8	58,1	4,7	102
-55	-1,2	19,8	45,3	8,9	56,5	4,6	102
-56	-1,3	20,3	44,5	9,0	54,8	4,6	102
-57	-1,3	20,8	43,7	9,1	53,0	4,6	103
-58	-1,3	21,3	42,9	9,1	51,1	4,5	103
-59	-1,3	21,9	42,1	9,1	49,1	4,5	104
-60	-1,3	22,6	41,3	9,1	47,0	4,5	105
-61	-1,3	23,2	40,5	9,1	44,8	4,4	106
-62	-1,3	23,8	39,6	9,1	42,4	4,3	107
-63	-1,3	24,5	38,8	9,1	39,8	4,3	109
-64	-1,4	25,2	38,0	9,2	37,1	4,2	111
-65	-1,4	25,9	37,2	9,2	34,2	4,2	113
-66	-1,4	26,7	36,3	9,2	31,1	4,1	116
-67	-1,4	27,5	35,5	9,2	27,7	4,1	121
-68	-1,4	28,4	34,7	9,2	24,1	4,0	125
-69	-1,4	29,3	33,9	9,2	20,2	3,9	130
-70	-1,4	30,2	33,0	9,1	16,1	3,8	136
-71	-1,4	31,3	32,2	9,0	11,6	3,9	143
-72	-1,4	32,5	31,3	8,9	6,8	4,0	151
-73	-1,4	33,8	30,4	8,8	1,6	4,2	160
-74	-1,4	35,4	29,5	8,6	-4,0	4,5	171
-75	-1,4	37,1	28,7	8,4	-10,0	5,1	183
-76	-1,5	38,9	27,8	8,2	-16,5	5,9	196
-77	-1,5	41,0	27,0	8,0	-23,5	7,1	211
-78	-1,5	43,3	26,1	7,8	-31,1	8,8	229
-79	-1,5	46,0	25,3	7,5	-39,2	11,2	249
-80	-1,5	49,1	24,4	7,2	-48,0	14,3	271
-81	-1,5	52,5	23,5	6,8	-57,5	18,5	296
-82	-1,5	56,5	22,6	6,3	-67,8	24,0	324
-83	-1,5	61,1	21,8	5,8	-78,8	31,2	355
-84	-1,5	66,3	20,9	5,2	-90,8	40,6	36
-85	-1,5	72,4	20,0	4,6	-103,7	52,7	69
-86	-1,5	79,4	19,1	3,8	-117,6	68,3	113
-87	-1,5	87,4	18,2	2,9	-132,6	88,2	161
-88	-1,6	96,8	17,3	2,0	-148,6	113,4	215
-89	-1,6	107,7	16,4	1,0	-165,9	145,2	275
-90	-1,6	120,1	15,5	0,0	-184,3	184,7	340

TABLE (48)

Comparison of the general formula (43) with individual observations

№	1. long. λ	lat. φ	δ_c	i_c °	i_c '	$\delta_c - \delta_o$
1. Saïda Algier	0,1	34,8	+14,9	52	51	−1,4
2. Port St. Maur	2,5	48,8	+16,2	65	17	−1,2
3. Barcelona	2,2	41,4	+15,1	59	21	−1,2
4. Marseille	5,4	43,3	+14,9	60	26	−1,2
5. Ajaccio	8,8	41,9	+12,5	58	47	−1,1
6. Carthago	10,3	36,9	+11,4	53	6	−1,6
7. Lauré	10,6	35,8	+11,4	52	0	−1,6
8. Ratzeburg	10,8	53,7	+12,5	67	56	−0,3
9. Tripoli	13,2	32,9	+11,9	47	42	−1,2
10. Berlin	13,4	52,5	+10,9	67	0	−0,9
11. Neapel	14,2	40,9	+10,6	56	57	−0,8
12. Kap Thordsen	15,7	78,5	+12,8	80	29	+4,4
13. Oppeln	17,9	50,7	+8,3	65	1	−0,9
14. Schmaisen	21,7	56,4	+5,5	68	21	−1,3
15. Bossekop	23,3	70,0	+4,0	76	32	+0,3
16. Sodankyla	26,6	67,4	+1,5	74	48	−0,5
17. Smyrna	27,2	38,4	+5,9	53	12	−0,3
18. St. Petersburg	30,3	60,0	+0,7	70	50	−0,4
19. Moskau	37,6	55,8	−2,1	68	35	+0,1
20. Tobolsk	68,2	58,2	−13,0	71	53	+0,8
21. Ischim	69,5	56,1	−12,7	70	13	+0,2
22. Omsk	73,4	55,0	−11,9	69	53	+0,7
23. Narüm	81,6	58,9	−13,2	73	49	+0,7
24. Barnaul	83,8	53,3	−10,1	69	36	+0,9
25. Yeniseisk	92,2	58,5	−9,4	74	49	+1,3
26. Irkutsk	104,3	52,3	−3,0	70	3	+0,2
27. Saigon	106,7	10,8	−2,2	7	51	−1,2
28. Hongkong	114,2	22,3	−0,2	32	10	−0,9
29. Peking	116,5	39,9	+2,6	57	24	+0,9
30. Tientsin	117,2	39,1	+2,8	56	34	+0,6
31. Cheischui	118,5	43,8	+3,9	60	42	+1,0
32. Nertschinsk	119,3	51,3	+3,2	68	22	+0,7
33. Chefoo	121,4	37,5	+4,0	54	11	+0,2
34. Shanghai	121,5	31,2	+2,5	46	14	+0,2
35. Fakou-san	123,1	42,5	+5,2	59	48	+1,1
36. Tondjan	123,8	42,1	+7,3	64	49	+2,8
37. Blagowestschensk	127,5	50,3	+8,6	66	7	+2,8
38. Point Barrow	203,0	71,3	−32,6	81	22	+1,1
39. Fort Rae	244,3	62,6	−40,4	82	57	+1,1
40. Santiago	284,2	20,0	−2,6	48	40	+1,5
41. Kingua Fjord	292,7	66,6	+72,3	83	51	+12,6
42. Baie Gaspé	295,5	48,8	+25,3	77	21	−0,7
43. Pointe à Pitre	298,5	16,2	+0,9	47	5	−4,6
44. Dakar	342,7	14,7	+19,2	32	32	+1,1
45. Jan Mayen	351,5	71,0	+29,9	78	52	−4,2

$$u = -(-18,52)\cdot i^{0} + (-77,146)\cdot i^{30}, \quad u^{(1)} = 9,2 + (-14,03)\cdot i^{0,0133} + (-57,011)\cdot i^{30}, \quad u^{(2)} = 20,3 + (-4,05)\cdot i^{60}$$
$$u^{(3)} = 5,3 + (-4,24)\cdot i^{0,24}, \quad u^{(4)} = 10,3 + (-0,079)\cdot i^{1}, \quad u^{(5)} = 4,8 - (-3,20)\cdot i^{2} + (-56,66)\cdot i^{30}$$
$$u^{(6)} = 12,7 - 0,8\cdot i + (-18,2)\cdot i^{30}, \quad u^{(7)} = 1,7 + (-42,45)\cdot i^{0,5}, \quad u^{(8)} = 19,8 + (-4,079)\cdot i^{2} + (-37,08)\cdot i^{30}$$

and in (47), according to formula (45)

$$u = -\tfrac{1}{2}\, i^{0,5}, \quad u^{(1)} = 9,2 + (-3,326)\cdot i^{0,5} + (-42,45)\cdot i^{30}, \quad u^{(2)} = 20,3 - (-0,631)\, i^{0,5}$$

In Table (48) all values of ϕ and i_b arepositive; δ_b signifies the observed declination, valid for 1885. In the main, it is reduced to 1885, as are, e.g., my observations of the 24 locations, numbers 8, 10, 13, 14, 18 to 37. δ_r is the declination, computed according to (43) with the help of the observed inclination, i_b. The average of the deviations $\delta_b - \delta_r$ of formula (43) from observations is ±1.08°, disregarding signs, and excluding the location no. 41, which is near the magnetic North Pole, since this location deviates too much. On the whole, formulas (43) and (45) become inexact in the neighborhood of the magnetic poles where the declination changes very rapidly, while on the other hand, the compass needle assumes there an easily found position, since it points everywhere toward the nearby pole--so long as there is still sufficient directive force in the horizon.

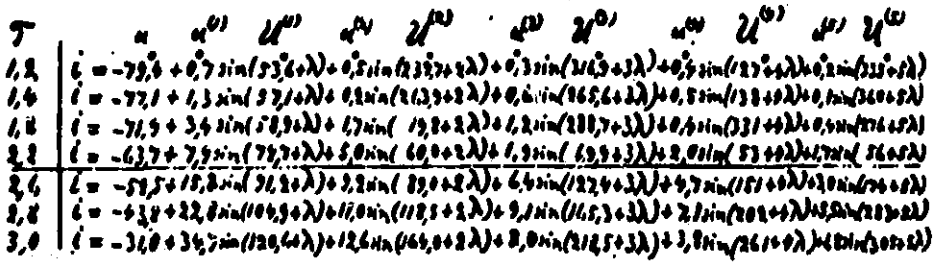
B. The above tables (40) and (41) served for the derivation of the equation for i as a function of τ and λ. For the 18 equidistant values of i for the northern hemisphere in which i is positive, I found:

Formula (49).

τ	u	$u^{(1)}$	$u^{(2)}$	$u^{(3)}$	$u^{(4)}$	$u^{(5)}$	$u^{(6)}$
0,6	$i = 83,2 + 0,6\sin(194,9+\lambda) + 0,2\sin(346,9+2\lambda) + 0,1\sin(-90°+3\lambda)$						
1,0	$i = 80,0 + 0,9\sin(220,9+\lambda) + 0,5\sin(253,3+2\lambda) + 0,2\sin(141+3\lambda)$						
1,4	$i = 75,8 + 1,3\sin(245,2+\lambda) + 1,2\sin(272,1+2\lambda) + 0,2\sin(226+3\lambda)$						
1,8	$i = 70,7 + 1,6\sin(247,0+\lambda) + 1,9\sin(277,7+2\lambda) + 0,2\sin(273+3\lambda)$						
2,2	$i = 65,1 + 2,5\sin(248,1+\lambda) + 2,7\sin(266,3+2\lambda) + 0,3\sin(358+3\lambda)$						
2,6	$i = 57,5 + 2,1\sin(249,1+\lambda) + 5,4\sin(264,2+2\lambda) + 1,0\sin(384+3\lambda)$						
2,8	$i = 52,3 + 2,7\sin(256,3+\lambda) + 7,4\sin(269,5+2\lambda) + 1,1\sin(367+3\lambda)$						
3,0	$i = 45,2 + 4,6\sin(271,8+\lambda) + 11,3\sin(272,4+2\lambda) + 1,6\sin(334+3\lambda)$.						

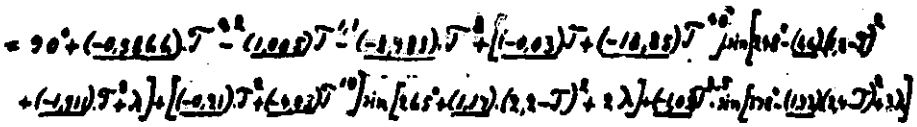
and for the southern hemisphere, where positive and negative inclinations i occur:

Formula (50)



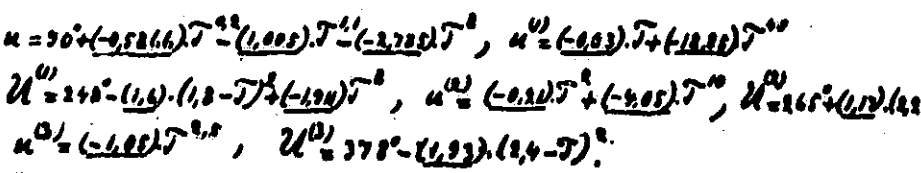
Thus, we obtain, in accordance with the formulas (49), whose vertical number rows are functions of τ, for the northern magnetic hemisphere, where i is positive

Formula $(49)_\alpha$



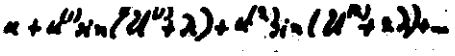
Here again the factors enclosed in parentheses and underscored are logarithms which are inserted in place of their numbers.

For the southern magnetic hemisphere the simple formula (53) given below must be applied instead of the above formulas (50) while the latter are too complicated and are very irregular with respect to τ, so that they would yield inspect results. In the auxiliary table $(49)_\beta$, which I have combined with formula $(49)_\alpha$ in order to facilitate computation, the symbols $\alpha, \alpha^{(1)}, \lambda^{(1)}, \alpha^{(2)}, \lambda^{(2)}$ etc have the following meaning:



C. The horizontal intensity, τ, represented as a function of i and λ

Finally, I calculated again with the observational data of the above tables (38) and (39) the following equations of the form



AUXILIARY TABLE $(49)_\beta$ for formula $(49)_\alpha$ /73

τ	u	$a^{(1)}$	$\lambda^{(1)}$	$a^{(2)}$	$\lambda^{(2)}$	$a^{(3)}$	$\lambda^{(3)}$	τ	u	$a^{(1)}$	$\lambda^{(1)}$	$a^{(2)}$	$\lambda^{(2)}$	$a^{(3)}$	$\lambda^{(3)}$
0,1	89,9	0,1	338,9	0,0	330	0,0	-72°	1,7	72,1	1,6	194,5	0,1	268°	0,3	336°
0,2	88,5	0,2	196,0	0,0	329	0,0	-34	1,8	70,8	1,7	192,0	0,0	267	0,3	337
0,3	87,5	0,3	158,4	0,1	328	0,0	3	1,9	69,5	1,8	190,1	0,1	266	0,3	337
0,4	86,5	0,4	174,0	0,1	313	0,0	38	2,0	68,2	1,9	188,5	0,1	265	0,3	4
0,5	85,5	0,5	180,7	0,2	308	0,0	71	2,1	66,8	2,0	187,0	0,2	265	0,4	18
0,6	84,4	0,6	180,7	0,2	303	0,0	102	2,2	65,3	2,1	186,3	0,2	265	0,4	18
0,7	83,4	0,7	179,8	0,3	298	0,0	132	2,3	63,7	2,1	185,4	0,3	265	0,5	17
0,8	82,3	0,7	178,2	0,4	294	0,0	160	2,4	62,0	2,2	184,2	0,3	265	0,5	17
0,9	81,2	0,8	176,2	0,5	290	0,1	186	2,5	60,1	2,3	183,2	0,3	266	0,5	17
1,0	80,1	0,9	173,5	0,6	286	0,1	211	2,6	58,0	2,4	182,1	0,5	267	0,6	18
1,1	79,1	1,0	170,5	0,7	283	0,1	234	2,7	55,5	2,5	180,5	0,3	269	0,7	20
1,2	77,9	1,1	167,3	0,8	280	0,1	255	2,8	52,7	2,7	178,6	0,4	270	0,8	4
1,3	76,8	1,2	163,1	1,0	277	0,2	275	2,9	49,5	3,1	176,2	0,9	272	1,3	347
1,4	75,7	1,3	158,8	1,2	274	0,2	293	3,0	45,6	4,5	173,2	1,8	279	2,4	349
1,5	74,5	1,4	154,7	1,4	272	0,2	309	3,1	41,2	5,0	169,5	1,3	277	1,5	336
1,6	73,3	1,5	150,9	1,6	270	0,2	324								

Formulas (51)

i	u
+85°	$\tau = 0{,}96 + 0{,}07\sin(292{,}7+\lambda) + 0{,}01\sin(288{,}4+2\lambda) + 0{,}02\sin(45°+3\lambda)$
+80	$\tau = 1{,}02 + 0{,}06\sin(281{,}6+\lambda) + 0{,}05\sin(259{,}7+2\lambda) + 0{,}02\sin(117+3\lambda)$
+75	$\tau = 1{,}07 + 0{,}10\sin(283{,}5+\lambda) + 0{,}09\sin(274{,}0+2\lambda) + 0{,}01\sin(0+3\lambda)$
+70	$\tau = 1{,}88 + 0{,}12\sin(243{,}0+\lambda) + 0{,}14\sin(274{,}5+2\lambda) + 0{,}03\sin(20+3\lambda)$
+60	$\tau = 2{,}50 + 0{,}12\sin(244{,}9+\lambda) + 0{,}23\sin(263{,}9+2\lambda) + 0{,}04\sin(26+3\lambda)$
+45	$\tau = 3{,}07 + 0{,}09\sin(300{,}2+\lambda) + 0{,}30\sin(273{,}0+2\lambda) + 0{,}04\sin(78+3\lambda)$
+30	$\tau = 3{,}32 + 0{,}17\sin(309{,}3+\lambda) + 0{,}25\sin(284{,}9+2\lambda) + 0{,}04\sin(94+3\lambda)$
+15	$\tau = 3{,}42 + 0{,}30\sin(312{,}6+\lambda) + 0{,}23\sin(302{,}3+2\lambda) + 0{,}06\sin(67+3\lambda)$
0	$\tau = 3{,}41 + 0{,}45\sin(309{,}2+\lambda) + 0{,}17\sin(314{,}5+2\lambda) + 0{,}09\sin(47+3\lambda)$
-15	$\tau = 3{,}31 + 0{,}57\sin(305{,}1+\lambda) + 0{,}14\sin(315{,}6+2\lambda) + 0{,}09\sin(27+3\lambda)$
-30	$\tau = 3{,}14 + 0{,}61\sin(298{,}4+\lambda) + 0{,}11\sin(286{,}3+2\lambda) + 0{,}06\sin(2+3\lambda)$
-45	$\tau = 2{,}92 + 0{,}54\sin(286{,}1+\lambda) + 0{,}16\sin(286{,}7+2\lambda) + 0{,}06\sin(-70+3\lambda)$
-60	$\tau = 2{,}68 + 0{,}36\sin(269{,}5+\lambda) + 0{,}20\sin(287{,}3+2\lambda) + 0{,}02\sin(-18+3\lambda)$
-70	$\tau = 1{,}96 + 0{,}21\sin(253{,}1+\lambda) + 0{,}09\sin(286{,}6+2\lambda) + 0{,}07\sin(61+3\lambda)$
-75	$\tau = 1{,}62 + 0{,}14\sin(236{,}3+\lambda) + 0{,}04\sin(188{,}5+2\lambda) + 0{,}08\sin(65+3\lambda)$
-78,5	$\tau = 1{,}25 + 0{,}09\sin(239{,}4+\lambda) + 0{,}03\sin(31{,}3+2\lambda) + 0{,}03\sin(93+3\lambda).$

From these I derived the general formulas (52) and (53)

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For the northern magnetic hemisphere in which i is positive:

Formulas (52)

$$T = 3{,}46 - (-5{,}359)i^{1} - (-12{,}194)i^{2} + [(-1{,}270)\cdot(90^\circ - i)^{0{,}5} + (-10{,}53)\cdot(90^\circ - i)^{2}]\sin[92^\circ + (0{,}55)(90^\circ - i)^{0{,}9} - (-4{,}921)(90^\circ - i)^{1{,}5} + \lambda] + [(-2{,}915)(90^\circ - i)^{1{,}5} - (-4{,}93)(90^\circ - i)^{2{,}5}]\sin[272^\circ + (-9{,}9)(90^\circ - i)^{2} + 2\lambda] + [(-3{,}506)(90^\circ - i)^{1{,}8}]\sin[17^\circ - (-1{,}20)(i - 36^\circ)^{2} + 3\lambda]$$

For the southern hemisphere where i is negative. In formula (53) i is to be inserted as a positive number

Formulas (53)

$$T = 3{,}46 + (-1{,}2218)i^{0{,}5} - (-2{,}1763)i^{1{,}5} - (-10{,}376)i^{2{,}5} + [(-2{,}313)\cdot(90^\circ - i)^{1{,}25} - (-5{,}915)(90^\circ - i)^{2}]\sin[192^\circ + (0{,}846)(90^\circ - i)^{\frac{3}{2}} - (-4{,}51)(90^\circ - i)^{\frac{5}{2}} + \lambda] + (-1{,}7353)\cdot(90^\circ - i)^{0{,}5}\sin[118^\circ - (-1{,}70)i^{2{,}2} + (-2{,}2)i^{5} + 2\lambda] + (-3{,}0)\cdot(90^\circ - i)\sin[29^\circ - (-0{,}778)i + 3\lambda]$$

The factors in parentheses which are underscored in formulas (52) and (53) are logarithms, which I have inserted in place

of their numbers.

The following auxiliary table (54) gives the quantities $u, u'', u''', u^{(4)}, u^{(5)}$ etc. with the argument i and serves to facilitate the computations with formula (52) and I have set:

$$u = 3,46 - (-2,359)\,i^{3} - (-12,144)\,i^{4}, \quad u'' = (-1,7)(90^{\circ}-i)^{0,5} + (-10,95)(90^{\circ}-i)^{5}$$
$$u''' = 192^{\circ} + (0,55)(90^{\circ}-i)^{2,0} - (-0,921)(90^{\circ}-i)^{2,5}, \quad u^{(4)} = (-2,915)(90^{\circ}-i)^{4,5} - (-4,83)(90^{\circ}-i)^{5,5}$$
$$u^{(5)} = 272^{\circ} + (-4,2)(90^{\circ}-i)^{3}, \quad u^{(6)} = (-3,406)(90^{\circ}-i)^{6,2}, \quad u''' = 87^{\circ} - (-1,30)(i-34^{\circ})^{2}$$

In the auxiliary table (55) to formula (53) which follows (54), we have:

$$u = 3,46 + (-1,2918)\,i^{1,5} - (-2,1763)\,i^{4,5} - (-10,375)\,i^{5,5}, \quad u'' = (-2,313)(90^{\circ}-i)^{1,25} - (-5,915)(90^{\circ}-i)^{3}$$
$$u''' = 192^{\circ} + (0,846)(90^{\circ}-i)^{2} - (-6,51)(90^{\circ}-i)^{4}, \quad u^{(4)} = (-1,7342)(90^{\circ}-i)^{4,5}$$
$$u^{(5)} = 318^{\circ} - (-1,7)\,i^{2,5} + (-7,2)\,i^{5}, \quad u^{(6)} = (-3,00)(90^{\circ}-i), \quad u^{(7)} = 29^{\circ} - (-0,178)\,i$$

It is to be generally noted that i in all the preceding formulas from (37) on is to be expressed in degrees and their fractions, and it will be obtained from them in this form also.

Comparison of the foregoing formulas between i and τ with individual observations /76

Comment on the vertical Column A in the following tables (56), (57) and (58): The inclination i_r is computed according to the formula $\operatorname{tg}(i_r - 4) = a(0,592 - \frac{1}{6}\tau_r)$; $(i_b - i_r)$ is given in minutes, and $(\tau_b - \tau_r)$ in Gaussian units of the third decimal place; the horizontal intensity τ_r is computed by means of the formula $\frac{1}{6}\tau_r = 0,592 - \frac{1}{a}\operatorname{tg}(i_r - 4)$ (cf. the above formula (6)); finally, i_b is the observed inclination and τ_b is the observed horizontal intensity; i_r is calculated according to the above formula $(49)_{\alpha}$, and τ_r by means of formula (52) or (53); $(i_b - i_r)$ is expressed in degrees and tenths of a degree and $(\tau_b - \tau_r)$ in Gaussian units, just as are τ_r and τ_b.

Auxiliary formula (54) to formula (52)

i	u	$u^{(1)}$	$\mathcal{U}^{(1)}$	$u^{(2)}$	$\mathcal{U}^{(2)}$	$u^{(3)}$	$\mathcal{U}^{(3)}$
+90°	0,00	0,00	192°	0,00	272°	0,00	-70°
+88	0,15	0,01	199	0,00	272	0,00	-59
+86	0,30	0,04	205	0,01	272	0,00	-48
+84	0,62	0,05	210	0,02	272	0,00	-38
+82	0,83	0,05	215	0,03	272	0,00	-28
+80	1,03	0,06	220	0,05	272	0,01	-19
+78	1,22	0,06	225	0,06	272	0,01	-10
+76	1,40	0,07	230	0,07	272	0,01	-1
+74	1,57	0,08	235	0,09	272	0,01	7
+72	1,73	0,08	240	0,10	272	0,01	15
+70	1,87	0,09	244	0,11	272	0,01	22
+68	2,01	0,09	248	0,13	273	0,02	29
+66	2,14	0,09	253	0,14	273	0,02	36
+64	2,26	0,10	258	0,15	273	0,02	42
+62	2,37	0,10	262	0,17	273	0,02	48
+60	2,48	0,11	266	0,18	274	0,02	53
+58	2,58	0,11	270	0,19	274	0,02	58
+56	2,67	0,12	274	0,20	274	0,03	63
+54	2,75	0,12	278	0,22	274	0,03	67
+52	2,83	0,12	282	0,23	275	0,03	71
+50	2,90	0,13	286	0,24	276	0,03	74
+48	2,97	0,13	289	0,25	277	0,03	77
+46	3,03	0,14	292	0,26	277	0,04	80
+44	3,08	0,15	295	0,27	278	0,04	82
+42	3,13	0,15	298	0,28	279	0,04	84
+40	3,18	0,15	301	0,28	280	0,04	85
+38	3,22	0,16	304	0,29	281	0,04	86
+36	3,26	0,17	307	0,29	282	0,05	87
+34	3,29	0,17	309	0,30	283	0,05	87
+32	3,32	0,17	311	0,30	284	0,05	87
+30	3,34	0,18	313	0,30	285	0,05	86
+28	3,36	0,19	315	0,30	287	0,06	85
+26	3,38	0,20	317	0,30	288	0,06	84
+24	3,40	0,20	318	0,30	290	0,06	82
+22	3,42	0,21	319	0,30	292	0,06	80
+20	3,43	0,22	320	0,29	294	0,06	77
+18	3,44	0,24	321	0,29	296	0,06	74
+16	3,44	0,25	321	0,28	298	0,07	71
+14	3,45	0,26	321	0,27	300	0,07	67
+12	3,45	0,28	321	0,26	302	0,07	63
+10	3,46	0,29	320	0,25	304	0,07	58
+8	3,46	0,31	319	0,24	307	0,08	53
+6	3,46	0,33	318	0,23	309	0,08	48
+4	3,46	0,35	316	0,21	312	0,08	42
+2	3,46	0,37	315	0,19	315	0,08	36
0	3,46	0,40	313	0,17	318	0,09	29

(5 Auxiliary formula (55) to formula (53)

i	u	$u^{(1)}$	$\mathcal{U}^{(1)}$	$u^{(2)}$	$\mathcal{U}^{(2)}$	$u^{(3)}$	$\mathcal{U}^{(3)}$
-90°	0,00	0,00	192°	0,00	293°	0,00	-34°
-88	0,30	0,01	201	0,03	293	0,00	-29
-86	0,57	0,03	209	0,04	295	0,00	-28
-84	0,82	0,05	218	0,05	298	0,01	-27
-82	1,05	0,07	226	0,06	301	0,01	-25
-80	1,26	0,09	235	0,06	312	0,01	-24
-78	1,45	0,11	243	0,07	310	0,01	-23
-76	1,63	0,13	253	0,07	304	0,01	-22
-74	1,79	0,15	257	0,08	301	0,02	-20
-72	1,93	0,17	260	0,08	297	0,02	-19
-70	2,06	0,19	264	0,09	295	0,02	-17
-68	2,17	0,22	267	0,09	295	0,02	-16
-66	2,27	0,25	271	0,09	296	0,02	-15
-64	2,37	0,27	274	0,09	298	0,03	-14
-62	2,46	0,29	277	0,10	301	0,03	-12
-60	2,54	0,31	280	0,10	304	0,03	-11
-58	2,61	0,33	283	0,11	308	0,03	-9
-56	2,68	0,35	286	0,11	313	0,03	-8
-54	2,73	0,37	288	0,11	318	0,04	-7
-52	2,78	0,39	290	0,11	323	0,04	-6
-50	2,84	0,41	293	0,12	328	0,04	-5
-48	2,89	0,42	296	0,12	334	0,04	-3
-46	2,93	0,44	299	0,12	340	0,04	-1
-44	2,96	0,45	301	0,13	346	0,05	0
-42	3,00	0,47	303	0,13	351	0,05	1
-40	3,04	0,49	305	0,13	357	0,05	3
-38	3,07	0,50	307	0,14	363	0,05	3
-36	3,10	0,50	309	0,14	369	0,05	5
-34	3,13	0,51	312	0,14	374	0,06	6
-32	3,16	0,52	314	0,14	379	0,06	8
-30	3,19	0,53	316	0,15	384	0,06	9
-28	3,22	0,54	317	0,15	389	0,06	10
-26	3,25	0,54	319	0,15	393	0,06	11
-24	3,27	0,54	321	0,15	397	0,07	13
-22	3,30	0,53	323	0,15	300	0,07	14
-20	3,32	0,53	324	0,15	303	0,07	16
-18	3,35	0,53	326	0,16	306	0,07	17
-16	3,37	0,53	327	0,16	309	0,07	18
-14	3,39	0,52	328	0,16	311	0,08	19
-12	3,41	0,51	329	0,16	313	0,08	21
-10	3,44	0,50	330	0,17	315	0,08	22
-8	3,46	0,48	330	0,17	316	0,08	24
-6	3,48	0,46	331	0,17	317	0,08	25
-4	3,50	0,44	332	0,17	318	0,09	26
-2	3,51	0,42	333	0,17	318	0,09	27
0	3,46	0,40	335	0,17	318	0,09	29

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The tables published previously by me in Treatise 1895 and the auxiliary tables (49), (54) and (55) were used in computing the quantities i_r and τ_r. The column (illegible) of the seven tables (56)-(62) indicates the year of the observation of i_b and τ_b.

TABLE (56) The zone between the latitudes +80° and +60° /76

No. place of observation	YR	lat. φ	long. λ	i_b	τ_b	Col. A. $(i_b - i_r)$	Col. A. $(\tau_b - \tau_r)$	Col. B. $(i_b - i_r)$	Col. B. $(\tau_b - \tau_r)$	Observer
1. Spitzbergen	1838	77,0	8,5	79° 38'	0,959	-24'	-33	+0,4	-0,02	Meyer
2. Lazen	1839	63,6	5,3	74 2	1,374	-4	-5	+0,3	-0,05	Gaimard
3. Danes Island	1868	79,7	11,0	80 51	0,855	-25	-40	-0,1	-0,01	Lemström
4. " "	1818	79,7	11,1	81 3	0,836	-18	-30	0,0	-0,04	Fisher
5. Spitzbergen	1827	76,3	14,6	79 50	0,960	+1	+2	+0,6	0,00	Keilhau
6. Advent Bay	1882	78,2	16,0	80 7	0,883	-38	-61	-0,3	-0,05	Lemström
7. Spitzbergen	1827	77,3	18,0	80 0	0,940	-6	-11	+0,5	-0,01	Keilhau
8. Bossekop	1840	70,0	23,5	76 17	1,218	-14	-19	+0,3	-0,05	Gaimard
9. Hammerfest	1870	70,7	23,7	76 45	1,172	-23	-32	0,0	-0,06	Belavenetz
10. Uleaborg	1857	65,0	25,5	74 6	1,358	-24	-30	0,0	-0,08	Kämtz
11. Vardöe	1870	70,4	31,1	76 45	1,184	-12	-18	0,0	-0,07	Belavenetz
12. Kanin Now	1870	68,7	43,5	76 8	1,259	-3	-3	-0,1	-0,07	"
13. Obdorsk	1829	66,5	66,7	76 7	1,335	+19	+35	-0,3	-0,03	Erman
14. Surgut	1883	61,3	73,3	74 30	1,523	+19	+24	0,0	-0,01	Fritsche
15. Troitzk Protok	1883	60,7	77,1	74 21	1,536	+6	+7	-0,1	-0,01	"
16. Troitzkoikloster	1825	65,8	88,2	77 46	1,248	+14	+21	+0,3	0,00	Hansteen
17. Fluss Nowaya	1843	72,1	95,5	81 36	0,869	+18	+29	+0,2	0,00	Middendorf
18. Wiluisk	1829	63,7	122,0	76 53	1,417	+38	+52	+1,0	+0,07	Due
19. Yakutsk	1829	62,0	129,8	74 18	1,625	+34	+42	+0,7	+0,06	Erman
20. Holy Cross Bay	1881	65,5	181,5	75 43	1,456	+28	+37	+0,5	+0,05	Lütke
21. Port Etches	1837	60,3	213,3	76 3	1,438	+27	+35	0,0	+0,01	Belcher

TABLE (56) The zone between the latitudes +80° and +60° continued (same headings)

/77

22. Fort of Good Hope	1844	66,3	231,5	82°	36′	0,774	+20′	+35	−0,6	−0,02	Lefroy
23. Fort Norman	1844	64,5	237,3	82	34	0,813	+17	+29	−0,6	−0,02	"
24. Fort Resolution	1844	61,1	249,2	82	45	0,814	+19	+32	−0,5	0,00	"
25. Winter Harbour	1820	74,8	249,2	68	42	0,128	−17	−21	−0,4	+0,01	Sabine
26. Byam Martin Island	1819	75,2	256,3	80	26	0,156	−11	−14	−0,8	+0,01	"
27. On ice, Waterfalls	1851	74,6	264,7	87	53	0,211	−4	−6	−0,7	+0,02	Ommaney
28. Regents Inlet	1819	72,6	270,3	88	27	0,155	−11	−15	−0,5	+0,01	Sabine
29. Igloolik	1822	69,3	278,4	88	10	0,183	−8	−12	−0,7	+0,02	Parry, Fisher
30. Port Foulke	1861	73,3	289,0	85	2	0,500	+5	+9	−1,0	−0,05	Hayes
31. Renssalaer harbour	1854	78,6	289,3	84	46	0,535	+3	+6	−0,9	−0,04	Kane
32. On ice	1818	75,1	300,0	84	25	0,533	−12	−21	−1,1	−0,07	Sabine
33. " "	1850	74,6	301,2	83	35	0,618	−13	−23	−0,9	−0,08	Ommaney
34. Godhaven	1861	69,2	306,5	81	51	0,813	+6	+7	−0,6	−0,05	Hayes
35. Reikiavik	1839	64,1	338,1	76	44	1,251	+40	+54	+0,7	0,00	Gaimard
Without regard to the signs, the average of table (56) is:							±16′	0,024	±26′	0,032	

TABLE (57) Zone between the latitudes +60° and +50° (same headings)

1. Dublin	1835	53,3	353,7	71°	5′	1,587	+25′	+27	+0,8	−0,03	Erman
2. Portsmouth	1830	50,7	358,9	68	33	1,725	+5	+5	+0,1	−0,04	"
3. Kew	1859	51,5	358,7	68	32	1,749	+20	+20	+0,4	−0,03	Lamont
4. Brüssel	1842	50,8	4,4	68	13	1,759	+7	+8	+0,4	−0,04	Quetelet
5. Kolding	1845	55,5	9,6	70	50	1,539	+13	+13	+0,6	−0,04	Hansteen
6. Göttingen	1850	51,5	9,9	67	22	1,799	−14	−14	+0,1	−0,06	Lamont
7. Petersburg	1845	53,7	10,8	68	16	1,771	+17	+17	+0,5	−0,03	Fritsche
8. Christiania	1822	59,9	10,8	72	34	1,486	+11	+12	+0,7	−0,03	Hansteen
9. Rostock	1858	54,1	12,1	68	39	1,744	+12	+12	+0,3	−0,04	Lamont
10. Berlin	1845	52,5	13,3	67	18	1,838	+16	+16	+0,4	−0,03	Fritsche
11. Breslau	1885	51,1	17,0	65	28	1,925	−22	−19	−0,2	−0,06	"
12. Oppeln	1885	50,7	17,9	65	8	1,953	−25	−23	−0,3	−0,06	"
13. Warsaw	1885	52,2	21,0	66	5	1,884	−37	−35	−0,4	−0,08	"
14. Jekmaisen	1885	54,4	25,7	68	20	1,780	+12	+12	+0,1	−0,05	"
15. Ekonäs	1851	60,0	23,5	70	58	1,598	−4	−5	+0,3	−0,06	"
16. Wilna	1885	54,7	25,3	67	23	1,829	−14	−14	−0,3	−0,07	"
17. Dorpat (Jurjew)	1850	58,4	26,7	70	51	1,614	−4	−4	+0,1	−0,06	Kämtz
18. St. Petersburg	1875	59,9	30,3	70	44	1,633	0	0	−0,1	−0,06	Fritsche
19. Moscow	1893	55,8	37,4	68	15	1,847	+16	+16	+0,1	−0,04	"
20. Nizni Nowgorod	1875	56,3	44,0	68	38	1,869	−23	−22	−0,6	−0,08	"
21. Tjumen	1847	57,1	65,4	70	43	1,758	−23	−25	−0,6	−0,06	"
22. Tobolsk	1875	58,2	68,2	71	43	1,721	+5	+5	−0,3	−0,04	"
23. Omsk	1875	55,0	73,4	69	43	1,917	+17	+17	0,0	0,00	"

TABLE (57) Zone between the latitudes +60 and +50 continued /78

24. Kainsk	1873	55,5	78,3	70° 38'	1,870	+11'	+12	−0,1	0,00	Fritsche
25. Narim	1882	58,9	81,6	73 46	1,628	+19	+23	+0,2	+0,02	"
26. Barnaul	1875	53,3	83,8	68 20	1,998	+15	+14	0,0	+0,02	"
27. Tomsk	1875	56,5	85,0	72 1	1,780	+10	+12	0,0	+0,01	"
28. Saloir	1874	54,3	85,8	70 13	1,934	+3	+3	−0,1	+0,01	"
29. Irkutsk	1875	52,3	104,3	69 57	2,015	+10	+10	0,0	+0,06	"
30. Stretensk	1881	52,2	117,7	69 6	2,063	+12	+12	−0,2	+0,06	"
31. Nertschinsk	1875	51,3	119,6	68 9	2,129	+10	+9	−0,3	+0,05	"
32. Tharanack	1820	60,0	119,7	73 36	1,626	+26	+31	+0,4	+0,04	Due
33. Ignashino	1883	53,5	122,5	69 43	2,006	+11	+12	−0,2	+0,06	Fritsche
34. Blagoweschtensk	1883	50,3	127,5	66 3	2,240	+7	+7	−0,2	+0,02	"
35. Ochotsk	1829	59,3	143,2	70 39	1,885	+28	+30	0,0	+0,05	Erman
36. Petropawlowsk	1829	53,0	158,7	63 50	2,287	+33	+30	+0,3	+0,06	"
37. Dovtschinsk	1829	56,5	160,7	68 11	2,039	+38	+36	+0,6	+0,07	"
38. At Sea	1830	54,5	221,0	73 34	1,665	+32	+37	+0,2	0,00	"
39. Sitka	1830	57,0	224,6	75 51	1,454	+12	+16	−0,3	−0,02	"
40. Saskatchewan River	1844	53,1	253,5	78 28	1,313	+49	+56	+0,1	+0,04	Lefroy
41. Devils Portage	1843	55,7	255,2	81 31	1,078	+35	+39	−0,2	0,00	"
42. Lake Winnipeg	1843	50,5	263,4	79 5	1,234	+6	+9	0,0	0,00	"
43. On ice	1846	57,2	277,5	86 30	0,601	−1	−2	−0,3	−0,01	Moore
The average of table (57) without regard to signs:						±16' ±0,017		±17' ±0,039		

TABLE (58) zone between latitudes +50° and +38°

№ Beobachtungsort	t	φ	λ	i_c	T_c	(i_c-i_o)	(T_c-T_o)	(i_c-i_o)	(T_c-T_o)	
1. Lissabon	1858	38,7	350,9	60° 39'	2,240	−33'	−35	+0,4	+0,04	Lamont
2. Santjago	1858	42,9	351,5	63 58	2,034	+16	+13	+0,6	0,00	"
3. Madrid	1858	40,4	356,3	61 6	2,172	−40	−31	+0,2	+0,02	"
4. Saragossa	1858	41,6	359,1	61 36	2,146	−28	−22	+0,3	+0,02	"
5. Poitiers	1858	46,6	0,3	65 8	1,970	+34	+29	+0,7	0,00	"
6. Orléans	1858	47,9	1,9	65 53	1,928	+36	+33	+0,9	−0,01	"
7. Paris	1842	48,9	2,3	67 6	1,821	−1	−1	+0,3	−0,04	"
8. Marseille	1858	43,3	5,4	61 40	2,136	−40	−31	0,0	0,00	"
9. Metz	1869	49,1	6,2	65 27	1,916	−6	−5	+0,2	−0,04	Perry
10. Genua	1850	44,4	8,9	62 23	2,103	−37	−30	−0,1	−0,01	Lamont
11. Würzburg	1850	49,8	9,9	66 23	1,872	−6	−6	+0,1	−0,04	"
12. Ulm	1842	48,4	10,0	65 43	1,909	−15	−14	+0,1	−0,04	"
13. Florence	1850	43,8	11,2	62 39	2,075	−82	−66	−0,3	−0,02	S. v. Waltershausen
14. Munich	1850	48,1	11,6	65 0	1,952	−21	−19	0,0	−0,04	Lamont
15. Vienna	1824	48,2	16,3	63 41	2,017	−17	−15	−0,2	−0,03	Observatorium
16. Urga	1875	47,9	106,9	65 59	2,295	+5	+4	−0,5	+0,05	Fritsche
17. Peking	1875	39,9	116,5	57 11	2,838	+89	+48	+0,5	+0,04	"

TABLE (58) Zone between the latitudes +50° and +38° continued /79

18.* [illegible]-daba	1873	46,5	118,0	61°	48'	2,567	+58'	+33	-0,7	+0,06	Fritsche
19.* Chei-schui	1873	43,0	118,5	60	26	2,640	+40	+25	-0,3	+0,03	"
20.* Galschi	1873	47,8	120,3	65	4	2,356	+41	+31	-0,2	+0,07	"
21. Jack River	1841	48,4	263,5	72	46	1,829	+72	+76	-0,1	+0,03	Kaly
22. Upper Fort Garry	1843	49,9	263,0	78	18	1,316	+8	+12	-0,1	+0,01	Lefroy
23. White River	1844	48,5	273,5	78	33	1,292	+7	+10	0,0	+0,01	"
24. Pointe au Crêpe	1843	47,0	275,0	77	12	1,452	+32	+41	+0,2	+0,05	"
25. Pointe au Croix	1843	43,9	277,7	76	31	1,507	+31	+37	+0,2	+0,04	"
26.* Washington	1839	38,9	283,0	71	6	1,987	+54	+49	-0,1	+0,07	Nav. Observatory
27. At Sea	1830	46,8	335,7	70	7	1,723	+68	+68	+0,3	0,00	Erman.
Average of Table (58) disregarding signs:							±34'	±0,029	±18'	±0,029	

TABLE (59) zone between the latitudes +50° and +30°

Note to Column A. i_r is computed by means of the formula $i_r = c\,T_t^{0,9}/(t_g\, i_r)^{0,9}$ and τ_r also by means of formula (20): $T_r = (\frac{i}{t})^{4} \cot g\, i_e$. $(\tau_b - \tau_r)$ is in Gaussian units of the 3rd decimal place in Column A.

In all the tables (56)-(62), i_b denotes the observed inclination and τ_b, the observed horizontal intensity expressed in Gaussian units.

1.* Lissabon	1858	38,7	350,9	60°	35'	2,210	+12'	+17	+0,4	+0,04	Lamont
2.* Santjago	1858	42,9	351,5	63	58	2,036	+11	+11	+4,6	0,00	"
3. Cadiz	1858	36,5	353,8	58	4	2,330	+14	+15	+0,5	+0,03	"
4.* Madrid	1858	40,4	356,3	61	6	2,172	+14	+7	+0,2	+0,02	"
5. Almeria	1858	36,9	357,5	57	27	2,346	+12	+11	+0,3	+0,03	"
6.* Saragosa	1858	41,6	359,1	61	36	2,146	+12	+10	+0,3	+0,02	"
7. Algiers	1842	36,8	3,1	57	14	2,388	+62	+44	+0,9	+0,05	"
8.* Marseille	1858	43,3	5,4	61	40	2,136	0	+1	0,0	0,00	"
9.* Florenz	1850	43,8	11,2	62	39	2,075	-23	-16	-0,3	-0,02	"
10. La Valette	1843	35,9	14,5	53	28	2,548	+25	+20	+0,5	+0,04	Hornung. Gibson
11. Messina	1848	38,2	15,6	55	28	2,442	-9	-3	-0,2	0,00	" "
12. Candia	1857	35,3	25,2	49	54	2,693	-31	-17	-0,3	+0,01	Schaub
13. Burgasz	1858	42,5	27,5	57	4	2,367	-82	-58	-4,4	-0,07	Kreil
14. Alexandria	1857	31,2	29,5	43	19	2,931	-47	-23	+1,3	+0,01	Schaub
15. Jaffa	1857	32,0	34,8	44	15	2,918	-105	-54	+0,1	-0,02	"
16. Astrachan	1830	46,3	48,1	60	3	2,347	-57	-50	-1,2	-0,08	Hansteen
17. Isfahan	1859	32,6	51,8	44	15	3,089	-69	-42	-4,1	-0,02	Lenz
18. Jezd	1859	31,9	54,5	42	42	3,156	-114	-56		-0,02	"
19. Nech	1858	31,4	60,0	43	16	3,205	-106	-47		-0,01	"
20. Herat	1858	34,3	62,0	46	38	3,125	-40	-23	-2,5	0,00	"

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TABLE (59) Zone between the latitudes +50° and +30° continued /80

21. Tair-wan	1860	44,8	106,9	63	7	2,555	+94'	+97	+0,2	+0,10	Fritsche
22. Kalgan	1875	40,8	114,9	58	15	2,818	+114	+101	+0,9	+0,08	"
23.* Peking	1875	39,9	116,5	57	11	2,838	+78	+73	+0,5	+0,04	"
24. Tsü-fu-lien	1871	35,6	117,0	51	56	3,075	+108	+68	+0,3	+0,02	"
25. Tsi-nan-fu	1871	36,7	117,0	53	12	3,024	+112	+73	+1,0	+0,03	"
26.* Tschobtu-dala	1873	44,5	118,0	61	48	2,567	+54	+52	-0,4	+0,05	"
27.* Chai-schai	1873	43,0	118,5	60	26	2,640	+54	+53	-0,3	+0,03	"
28. Chefoo	1871	37,5	121,4	53	54	2,952	+81	+58	+0,6	+0,01	"
29. Shanghai	1875	31,2	121,5	46	2	3,229	+53	+28		-0,03	"
30. Tsü-hu-ta	1871	40,4	122,2	57	29	2,803	+95	+80	+0,5	+0,05	"
31.* Jatochi	1843	47,8	126,3	65	4	2,356	+36	+41	-0,2	+0,07	"
32. At Sea	1830	31,8	234,2	56	15	2,776	0	+4	-1,2	-0,04	Erman
33. San Francisco	1866	37,8	237,5	62	22	2,603	+116	+118	+0,3	+0,10	Harkness
34. Pack River	1861	48,4	243,5	72	46	1,829	+18	+30	-0,1	+0,03	Haig
35. Colorado	1834	34,7	245,6	60	45	2,754	+144	+141	0,0	+0,11	U.S. Officers
36. Rio San José	1854	35,0	252,8	63	18	2,625	+126	+131	-0,9	+0,12	" "
37. Brown Settlement	1839	42,0	261,5	72	21	1,923	+58	+82	-0,2	+0,07	Locke
38. St. Louis	1839	38,6	269,9	69	31	2,170	+72	+94	-0,7	+0,10	"
39. Chicago	1842	41,9	272,3	72	39	1,894	+61	+83	-0,2	+0,07	Younghusband
40. White River	1844	48,5	273,5	78	33	1,293	+18	+34	0,0	+0,02	Lefroy
41. Pointe au Crépe	1843	47,0	275,0	77	12	1,452	+42	+63	+0,2	+0,05	"
42. Cincinnati	1840	39,0	275,6	70	27	2,097	+87	+109	-0,1	+0,11	Locke
43. Detroit	1845	42,4	277,1	73	39	1,761	+42	+67	-0,2	+0,05	Lefroy
44. Pointe au Croix	1843	45,9	278,7	76	31	1,507	+42	+61	+0,2	+0,04	"
45. Toronto	1845	43,6	280,6	75	15	1,632	+47	+69	+0,2	+0,05	Observatorium
46.* Washington	1842	38,9	283,0	71	18	1,998	+75	+101	+0,2	+0,10	Gillis, Lefroy
47.* "	1885	38,9	283,0	71	6	1,987	+57	+74	-0,1	+0,07	Nav. Observat.
48. Harrisburg	1862	40,3	283,1	72	32	1,849	+40	+56	-0,2	+0,04	Schott
49. New York	1844	40,7	286,0	72	43	1,851	+63	+84	+0,3	+0,06	Locke
50. Newhaven	1852	41,3	287,0	73	32	1,737	+32	+43	-0,1	+0,02	U.S. Coast Surv.
51. Boston	1852	42,4	289,0	74	6	1,689	+40	+34	+0,1	+0,08	Locke
52. Mount Desert	1856	44,3	291,8	76	9	1,502	+42	+61	+0,3	+0,03	U.S. Coast Surv.
53. At Sea	1830	34,1	320,1	64	30	2,158	+14	+10	+0,5	+0,00	Erman
54. " "	1830	44,8	335,7	70	7	1,724	+30	+32	+0,9	0,00	"
55. Funchal	1840	32,6	343,1	60	23	2,213	-34	-22	-0,2	+0,01	Ross
Average of Table (59) disregarding signs							±33'	±0,052	±29'	±0,003	

TABLE (60) zone between the latitudes +30° and 0°

i_r and τ_r in Column A are computed according to the above formula (37) $T = \left(\frac{i}{c}\right)^4 \cot g\, i + \left(\frac{11,40}{10,35+1}\right)^4$ with the help of the observed inclination i_b or the observed horizontal intensity τ_b.

observation location lat. long.

Ort der K. Beobachtung	t	Breite φ	Länge λ	i_t	T_t	Column Colonne d. $(i_t - i_r)$	$(T_t - T_r)$	Column Colonne D $(i_t - i_r)$	$(T_t - T_r)$	Observer
1. St. Thomas	1842	6,4	4,7	-0° 4'	3,345	-1'	-43		+0,18	Sabine
2. Bombay	1867	18,9	72,9	+19 2	3,719		+14		-0,07	Chambers
3. Aleppy	1870	9,5	76,3	-1 41	3,682	-69	-89		-0,09	Basevi
4. Badgaon	1868	29,7	72,6	+22 41	3,675		-74		-0,11	"
5. Kalianpoor	1867	24,1	72,7	+20 18	3,619		-75		-0,07	"
6. Bangalore	1869	13,0	77,7	+ 7 12	3,747		+134		-0,05	"
7. Galle	1892	6,0	80,2	- 8 7	3,641		+62		-0,11	Belcher
8. Madras	1870	13,1	80,3	+ 7 48	3,736		+129		-0,05	Basevi
9. Benares	1856	25,3	83,0	+32 41	3,685		- 83		-0,07	Schlagintweit
10 Calcutta	1854	22,5	88,3	+28 15	3,700		-66		-0,07	"
11 Fort Carnicobar	1858	9,2	92,7	+ 1 19	3,776	-67	-109		-0,01	Novara
12. Singkel	1876	2,3	97,7	-13 8	3,779		+53		-0,02	Rijkeworsel
13. Moulmein	1846	16,5	97,8	+17 46	3,741		-40		-0,13	Elliot
14. Tale Tsiang	1868	5,4	100,4	- 4 53	3,763	+138	+84		-0,10	"
15. Singapore	1875	1,3	103,9	-13 10	3,821		+68		0,00	Fritsche
16. Saigon	1875	10,8	106,7	+ 7 38	3,862		+209		+0,01	"
17 Hongkong	1835	22,3	114,2	+31 57	3,578		- 46		-0,02	"
18. Tomini	1876	0,5	120,5	- 1 3	3,849		+77		-0,04	Rijkeworsel
19. Manilla	1844	14,6	121,0	+16 26	3,715		+70		-0,03	Belcher
20 Bonin Island	1828	27,1	142,4	+26 48	3,190	-142	-59		-0,10	Lütke
21. Ulean	1828	2,4	144,0	+ 0 39	3,601	-106	-171		-0,17	"
22. Oahu	1838	21,3	202,0	+21 17	3,001	- 71	- 39		-0,05	Belcher
23. Owyhee	1830	19,7	203,8	+37 58	2,984		-148		-0,16	Douglas
24 Clarence Island	1839	12,3	205,3	+37 3	3,504		- 49		+0,02	Belcher
25. San Blas	1838	21,5	254,7	+44 36	3,501	+178	+98		+0,18	"
26. Mexico	1856	19,4	260,9	+41 26	3,695		-39		+0,10	Lieutenant Maury
27 Vera Cruz	1856	19,2	263,8	+43 58	3,968		+ 7		+0,15	"
28 New Orleans	1858	30,0	269,9	+39 49	2,899	+165	+160		+0,21	U.S. Coast Survey
29. Cuba Island	1838	3,6	273,0	+23 14	3,733		-67		+0,21	Belcher
30. Savannah	1857	32,2	279,6	+52 0	3,193	+91	+66		+0,19	Friesach
31. Panama	1866	9,0	280,5	+31 54	3,510		-185		+0,10	Harkness
32. St. Thomas	1865	18,3	295,1	+49 38	3,115	+13	+ 1		+0,18	"
33. Salute Island	1865	9,3	302,5	+34 35	3,110		-261		+0,03	"
34. At Sea	1839	27,8	318,5	+62 27	2,374	+28	+35		+0,08	Sulivan
35. " "	1830	11,0	333,4	+41 54	2,946		-30		+0,18	Erman
36. " "	1840	11,3	335,1	+41 1	2,905		-96		+0,11	Ross
37. " "	1838	23,2	339,2	+33 26	2,975	-128	-92		-0,01	Sulivan
38. Gambia River	1825	13,1	343,5	+40 23	3,003		+96		+0,21	Sabine
39. Santa Cruz	1845	28,5	343,7	+37 24	2,367	- 35	- 28		+0,01	Sulivan.
		Average of table (60 disregarding signs					±0,082		±0,094	

TABLE (61) Zone between the latitudes 0° and -27°
The signs in (61) have the same significance as in Table(60)

observation location — lat. long. — column — column — observer

N. Ort der Beobachtung	t	Breite φ	Länge λ	i_t	T_t	Kolonne α (i_t-i_r)	Kolonne α (T_t-T_r)	Kolonne β (i_t-i_r)	Kolonne β (T_t-T_r)	Beobachter
1. At Sea	1846	22,5	3,0	−34° 35′	2,005		−54		−0,12	H.M. Ship Fly
2. Tette	1858	16,1	33,5	−48 10	2,408	+120′	+55		−0,08	Livingstone
3. At Sea	1845	21,8	53,4	−54 51	2,309	+62	+38		−0,12	Moore
4. Seychelles	1848	4,6	55,5	−32 3	3,130		−32		−0,01	Belcher
5. Port Louis	1847	20,1	57,5	−53 49	2,407	+61	+38		−0,07	Rattlesnake
6. At Sea	1848	18,9	103,8	−46 43	3,209	−130	−85		+0,04	"
7. Batoe Radja	1876	4,1	104,2	−24 28	3,691		−82		0,00	Dijkevorsel
8. Lompongo	1847	5,4	105,3	−26 16	3,632		−114		−0,03	Elliot
9. Batavia	1876	6,2	106,8	−27 38	3,691		−73		+0,03	Observatorium
10. Amboina	1876	3,7	128,2	−20 0	3,826		−29		+0,02	Dijkevorsel
11. New Ireland	1840	4,7	152,7	−20 49	3,793	0	−18		+0,03	Belcher
12. Vakalea Island	1840	18,2	178,5	−36 9	3,641	0	−2		+0,20	"
13. At Sea	1830	26,8	210,0	−43 6	3,427		+115		+0,26	Erman
14. Otaheite	1830	17,5	210,5	−30 26	3,518		−45		+0,14	"
15. Payta	1866	5,1	278,9	+4 52	3,395		−41		+0,07	Herkness
16. Lima	1858	12,1	283,1	−7 10	3,234		+13		+0,05	Friesach
17. Auncion	1860	25,3	302,5	−18 4	2,834		−64		+0,05	"
18. Rio de Janeiro	1830	22,9	316,8	−13 35	3,012		+243		+0,32	Erman
19. Pernambuco	1839	8,1	325,1	+13 9	3,027		+75		+0,09	Salivan
20. At Sea	1847	7,7	330,9	+10 26	3,065		+166		+0,13	Rattlesnake
21. St. Helena	1840	15,9	354,3	−21 15	2,613	0	−19		−0,08	Observatorium
Average of Table (61) disregarding signs							±0,067		±0,032	

TABLE (62). Zone between the latitudes -27° and -40°
The signs in (62) have the same significance as in Table(60)

observation location — lat. long. — column — column — observer

N. Ort der Beobachtung	t	Breite φ	Länge λ	i_t	T_t	Colonne α (i_t-i_r)	Colonne α (T_t-T_r)	Colonne β (i_t-i_r)	Colonne β (T_t-T_r)	Beobachter
1. C. of Good Hope	1845	33,9	18,5	−53° 28′	2,081	+80′	+41		−0,22	Observatorium
2. At Sea	1846	34,4	51,4	−62 5	1,941	+21	+16		−0,22	H.M. Ship Fly
3. " "	1845	32,4	111,4	−62 22	2,521	−81	−89		−0,03	Moore
4. Fremantle	1846	32,0	115,8	−63 6	2,612	+15	+15		+0,07	H.M. Ship Fly
5. Port Jakson	1858	33,8	151,3	−62 41	2,687	−15	−17		−0,04	Novara
6. Morton Island	1849	27,1	153,4	−55 18	3,076	−58	−52		0,00	Rattlesnake
7. Bay of Island	1841	35,3	174,0	−59 36	2,812	−2	−4		−0,03	Terror
8. At Sea	1830	35,0	218,7	−52 26	2,935	−69	−50		−0,01	Erman
9. Valparaiso	1866	33,0	288,3	−35 23	2,917		−51		−0,02	Harkness
10. El Rosario	1858	32,9	299,5	−30 37	2,875		−30		+0,09	Macrae
11. Buenos Ayres	1852	34,6	301,6	−32 11	2,856		−19		+0,10	"
12. At Sea	1830	39,3	308,9	−40 19	2,588		−120		−0,08	Erman
13. " "	1847	36,5	335,7	−34 51	2,585		+33		+0,12	Rattlesnake
14. " "	1831	27,0	339,2	−23 46	2,562	0	−20		+0,02	Dunlop
15. " "	1847	38,3	359,4	−45 46	2,303	+148	+51		−0,09	Rattlesnake
Avg. of Tab. (62) disregarding signs							±0,042		±0,076.	

The average of our seven tables (56)-(62) yields accordingly /83 the following values of the columns A and B, of which the first, A, rests on the formulas (6), (7) and (37) of my Treatise 1895 and which I have (illegible) briefly mentioned here; the latter, B, however, rests on the formulas $(49)_\alpha$, (52), (53), newly found in the present paper, in which formulas the latitude ϕ does not appear at all, although it is replaced to a certain extent by the inclination i.

Mean deviations between observation and computation according to the formulas:

TABLE	Col. A $(i_b - i_r)$	Col. B $(i_b - i_r)$
(56)	16'	16'
(57)	16	17
(58)	34	18
(59)	53	29
average	±29.8	±22.5

TABLE	Col. A $(\tau_b - \tau_r)$	Col. B $(\tau_b - \tau_r)$
(56)	0,024	0,032
(57)	0,017	0,039
(58)	0,029	0,029
(59)	0,052	0,043
(60)	0,032	0,054
(61)	0,067	0,092
(62)	0,042	0,076
average	±0,045	±0,058

On the average, the inclination i is obtained somewhat more precisely in accordance with the new formula $(49)_\alpha$, than in accordance with the formulas (6), (7) and (37), previously obtained by me; the horizontal intensity τ on the contrary discloses, according to the new formulas (52) and (53), somewhat larger deviations $(\tau_b - \tau_r)$ than according to the previous formulas (6), (7) and (37).

However, when at a location either only i_b or only τ_b is observed, and we wish to compute the missing τ or i in accordance with my formulas, we can determine the latter much more exactly than, in accordance with the values $(i_b - i_r) = \pm 29.3'$ or $= \pm 22.5'$ and $(\tau_b - \tau_r) = \pm 0.045$ or $= \pm 0.058$ Gaussian units. This is to be expected since, as can be seen from Tables (56)-(62), the corrections to the formula values $(i_b - i_r)$ and $(\tau_b - \tau_r)$ are in most instances not of a chance kind, but change systematically from place to place on the Earth's surface. In order namely to obtain i and τ as exactly as possible for a definite place n, we must first compute them according to the formulas

mentioned, and correct the values thus obtained, i_r or τ_r, by the quantity $(i_b - i_r)$ or $(\tau_b - \tau_r)$, which are either interpolated from our Tables (56)-(62) for the location n, or else are found with the help of specially computed neighboring locations, whose i_b and τ_b are known. The same correction procedure can be applied in connection with the exact computation of the magnetic declination τ, in accordance with the formulas (43) and (45).

In Tables (60)-(62), many values of $(i_b - i_r)$ are missing--due to their uncertainty--while for lower latitudes we can indeed derive τ from i, but not i from τ with some precision with the help of the formulas.

The (illegible) changes of the factors a, a_3 and c of the above /84 formulas are very slight, as already mentioned.

In order also to obtain the degree of temporal change in the formulas (51), I have used the Tables (10) and (11) published in the supplement to Treatise 1895 which are borrowed from the works of Sabine, and then I have obtained by means of graphical representations the below Table (63) for the horizontal intensity τ. After converting the entire intensity given by Sabine in English units into Gaussian units, and multiplying the results by the cosine of the intensity, I entered as ordinates on a separate page for each longitude $\lambda = 0°, 30°, 60°$, etc., the inclination i of the mentioned Table (10) and the horizontal intensities τ which belonged to the same longitude as i, while the latitude ϕ formed the common abscissa for the two curves i and τ. Thus I obtained 12 pairs corresponding to the curves for i and τ, and was able accordingly to set up easily the Table (63) of the values τ, whose arguments are i and the longitude λ.

TABLE (63) valid for 1842

$i =$	$+80°$	$+75°$	$+70°$	$+60°$	$+45°$	$+30°$	$+15°$	$0°$	$-15°$	$-30°$	$-45°$	$-60°$	$-70°$	$-75°$	$-78,5$	
λ	T	T	T	T	T	T	T	T	T	T	T	T	T	T	T	λ
0°	0,90	1,37	1,62	2,20	2,77	3,00	3,03	2,78	2,45	2,48	2,13	2,17	1,86	1,62	1,48	0°
30	0,88	1,30	1,64	2,17	2,82	3,34	3,52	3,36	3,06	2,74	2,37	1,95	1,80	1,59	1,31	30
60	0,87	1,40	1,81	2,42	3,11	3,42	3,59	3,40	3,26	3,04	2,75	2,12	1,76	1,48	1,29	60
90	0,97	1,59	1,93	2,47	3,27	3,65	3,76	3,67	3,51	3,33	3,05	2,50	1,97	1,53	1,30	90
120	1,05	1,50	2,02	2,56	3,20	3,60	3,68	3,67	3,62	3,53	3,37	2,80	2,18	1,75	1,47	120
150	1,03	1,38	1,93	2,57	2,96	3,26	3,42	3,54	3,58	3,58	3,47	2,80	2,14	1,63	1,32	150
180	1,04	1,49	2,00	2,54	2,88	3,12	3,31	3,42	3,59	3,69	3,49	2,70	2,02	1,62	1,39	180
210	1,00	1,47	1,98	2,47	2,92	3,17	3,29	3,38	3,47	3,52	3,33	2,70	2,06	1,68	1,35	210
240	1,24	1,71	2,04	2,62	3,20	3,50	3,58	3,59	3,58	3,48	3,16	2,71	2,12	1,66	1,29	240
270	1,10	1,58	2,05	2,83	3,46	3,50	3,47	3,40	3,30	3,18	2,96	2,74	2,09	1,72	1,40	270
300	1,07	1,39	1,81	2,43	3,11	3,16	3,11	3,05	2,93	2,90	2,72	2,59	2,00	1,63	1,26	300
330	0,93	1,35	1,76	2,34	2,77	2,88	2,98	2,87	2,79	2,67	2,47	2,56	1,96	1,58	1,29	330

From this I have derived the following formulas:

Formulas (64) computed from the observations compiled by Sabine

i	
$+80°$	$T = 1,01 + 0,12 \sin(224,2° + \lambda) + 0,05 \sin(256,3° + 2\lambda)$
$+75$	$T = 1,46 + 0,09 \sin(245,3 + \lambda) + 0,10 \sin(231,9 + 2\lambda)$
$+70$	$T = 1,28 + 0,18 \sin(257,4 + \lambda) + 0,09 \sin(262,3 + 2\lambda)$
$+60$	$T = 1,50 + 0,16 \sin(244,0 + \lambda) + 0,19 \sin(251,7 + 2\lambda)$
$+45$	$T = 3,04 + 0,08 \sin(154,6 + \lambda) + 0,27 \sin(270,6 + 2\lambda)$
$+30$	$T = 3,30 + 0,15 \sin(328,5 + \lambda) + 0,27 \sin(286,5 + 2\lambda)$
$+15$	$T = 3,37 + 0,25 \sin(312,2 + \lambda) + 0,24 \sin(295,9 + 2\lambda)$
0	$T = 3,35 + 0,33 \sin(299,5 + \lambda) + 0,20 \sin(295,5 + 2\lambda)$

Formulas (64) continued

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i	
$-15°$	$T = 3,28 + 0,43 \sin(286,2° + \lambda) + 0,15 \sin(295,4° + 2\lambda)$
-30	$T = 3,19 + 0,54 \sin(276,7 + \lambda) + 0,09 \sin(278,8 + 2\lambda)$
-45	$T = 2,98 + 0,53 \sin(270,7 + \lambda) + 0,14 \sin(283,5 + 2\lambda)$
-60	$T = 2,52 + 0,34 \sin(247,6 + \lambda) + 0,19 \sin(282,6 + 2\lambda)$
-70	$T = 2,00 + 0,15 \sin(249,8 + \lambda) + 0,08 \sin(280,8 + 2\lambda)$
-75	$T = 1,62 + 0,08 \sin(229,0 + \lambda) + 0,04 \sin(196,7 + 2\lambda)$
$-78,5$	$T = 1,35 + 0,02 \sin(318,8 + \lambda) + 0,03 \sin(120,0 + 2\lambda)$

These equations which are valid for 1842, are almost the same as those I have derived for 1885 with the help of Neumayer's charts (cf. formulas (51)); in particular, the first term of the right side, the principal term, agrees very well. If we wanted now to set up a formula in which only the three magnetic elements δ, i and τ appeared as variables, then we would have to either eliminate λ from the equations (43), $(49)_\alpha$, (52), (53) which are respectively of the form $\delta = F(i, \lambda)$, $i = f(\tau, \lambda)$ and $\tau = g(i, \lambda)$ (where F, f and g are function symbols), or directly derive such a connection between δ, i and τ from the data of the above Tables (38)-(41). In the first case, it would be necessary in order to eliminate λ to expand $\sin\lambda$, $\cos\lambda$, $\sin 2\lambda$, etc., in powers of λ, according to the familiar sine and cosine series, and we would, if we would content ourselves with a rough approximation, and e.g., wanted to break off with the 7th, respectively the 6th power of λ, obtain ambiguous functions; in the second case, however, in order to find the Bessel sine series, we could successfully set no other argument in place of λ, neither δ, nor i, nor τ, as can easily be seen from the above Tables (38)-(41). That, corresponding to the functions $f(\delta, \lambda, \phi) = 0$, $F(i, \lambda, \phi) = 0$, $g(\tau, \lambda, \phi) = 0$, no function $F(\delta, i, \tau) = 0$, valid generally for the Earth's surface can be found, is clear without further ado from the magnetic charts (e.g., those of Gauss and Weber) since two of the line systems with equal δ, i, τ cannot replace the astronomical meridians and parallel circles as coordinates due to their complicated course.

Hence, we must forego an equation, valid for the entire terrestrial surface, which represents the connection between the three terrestrial magnetic elements δ, i and τ.

NOTES

Page 10. In the formula for P^{IV} the factor $\sin u^2$ is not clearly lithographed.

Page 26. $h^{4.4} = +0.0103$ and $h^{5.4} = +0.0132$ not clearly lithographed.

Page 27. Instead of "excluding the ... 48 values..." read: "Excluding the 15 coefficients $g^{7.m}$ and $h^{4.m}$ or P^{VI} and the two coefficients $g^{6.6}$, $h^{6.4}$, I have with the help of the remaining 46 values..."

Page 29. Horizontal row $u = 170°$, $M_3 = 0.004$; lithography unclear.

Page 32. For $u = 95°$ and $= 247.5$, $X = +3.416$ is unclear.

Page 51. Comment, next to the last row: $\tau = \frac{\tau}{200}$ unclear; last row is to read: "we must form therefore the sum G - A + a from δ, i, τ, if A represents the values in the Tables (30), (31) and (32)."

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